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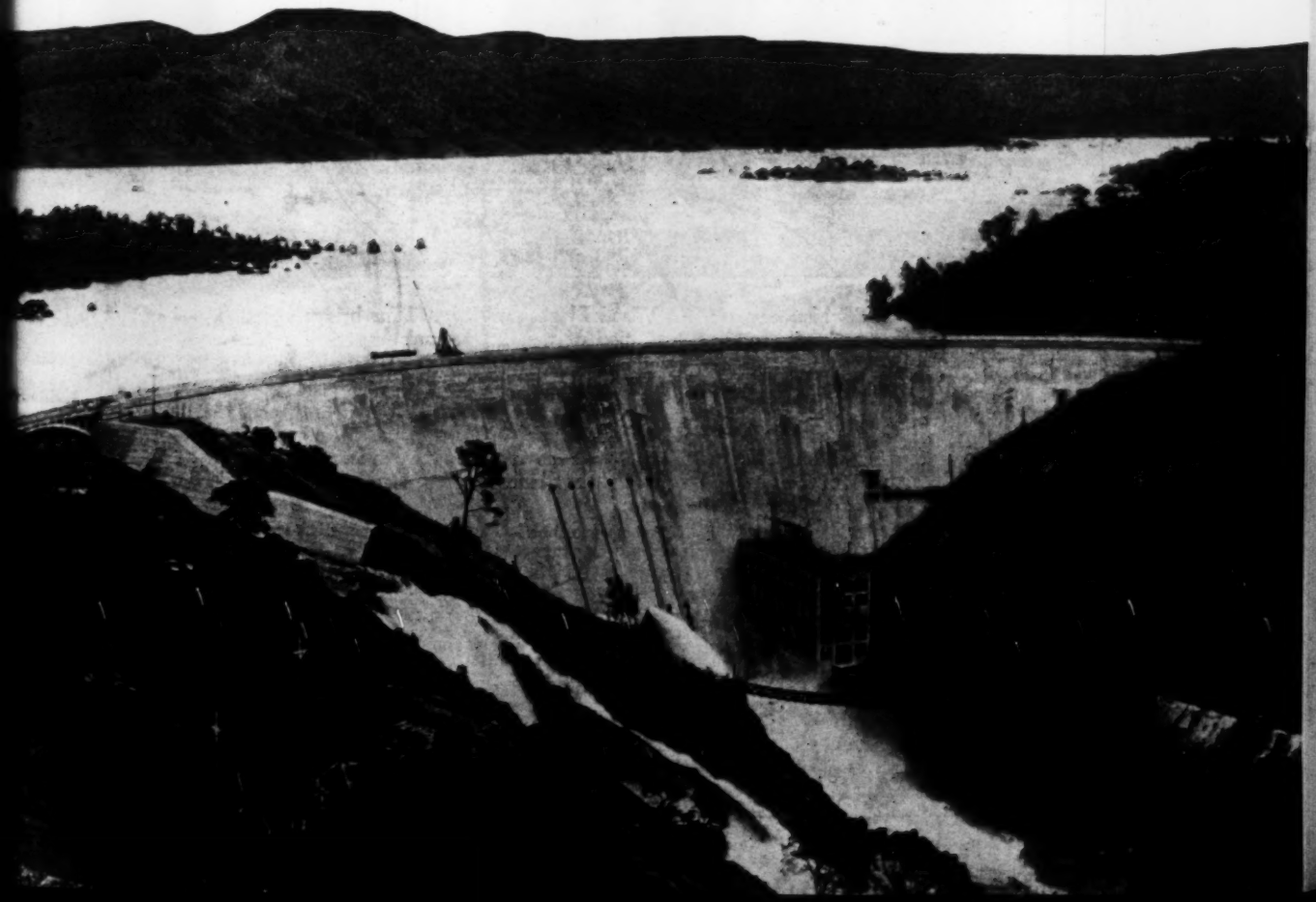
Alumina Cement in France

Building New Transandine Railway

Rose Polytechnic Institute's New Building

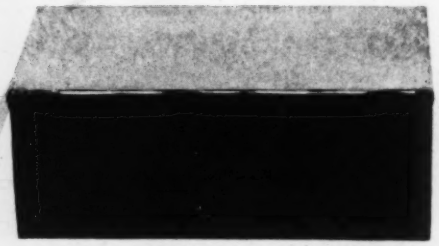
State Engineering in the Highway Bridge Field

Don Pedro Dam: An Irrigation Project
On the Tuolumne River, California

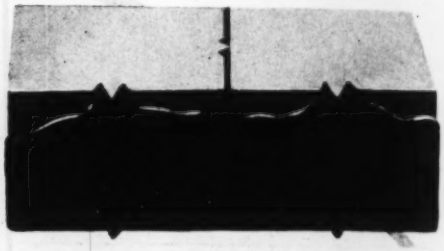


KREOLITE KOUNTERSUNK - LUG - BLOCKS

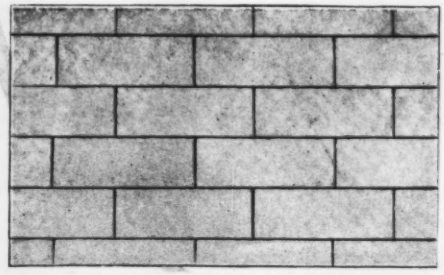
"The Paving that's Saving"



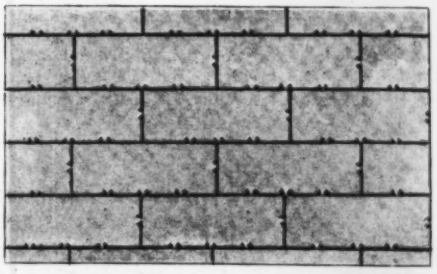
1—Showing imperfect penetration of filler with common rectangular block.



3—Showing nearly perfect penetration of filler with Kreolite Kountersunk Lug Blocks.



2—Plan view of plain or common rectangular blocks.



4—Plan view of Kreolite Kountersunk Lug Blocks.

KREOLITE Kountersunk Lug Wood Blocks are designed for bridge and street paving, and, with a slight variation of the kountersunk feature, for interior factory flooring.

This method of construction permits the penetration of the bituminous filler the entire depth of the block on all sides (see figure 3) securely binding it to the base and making a firm waterproof joint. The filler (our special make) is applied hot in liquid form and hardens when cool. The block cannot become loose because it is firmly attached to the base and to the adjacent blocks on four sides. In laying, only the tough end grain is exposed to wear.

In figure 2, the blocks make a good appearance, but is another case where beauty is only skin deep. The filler solidifies and fills only the upper part of the joint (see figure 1). Note bonding power, so essential to the permanence of any block pavement, as shown in figure 4.

To all City and County Officials, Contractors, Architects, Manufacturers, and others interested, we extend, gratis, the services of our trained engineers.

Write for detailed specifications and information.

The Jennison-Wright Company, 79 Kreolite Bldg., Toledo, Ohio.

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ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. MEHREN, *Editor*
FRANK C. WIGHT, *Managing Editor*

Volume 91 — NEW YORK, AUGUST 30, 1923 — Number 9

Their Appointed Rounds

OVER the portal of the general post office building in New York City is carved a sentence which, possibly because of the felicity of phrasing, has been credited to Woodrow Wilson: "Neither snow, nor rain, nor heat, nor gloom of night stays these couriers from the swift completion of their appointed rounds." When these words were written the airship was little more than a county fair attraction, but how aptly they convey the spirit of those pioneer planes which last week carried the mail across the continent in less than 27 hours. Step by step the world progresses and each tiny movement forward seems so insignificant, until with time we find ourselves in new countries with new landmarks and new conditions. Thus will it be with air transportation; first a toy, then a weapon, still later an experiment for the rich and the curious, before long, as the world counts time, the airship will be a potent factor in transportation.

Traffic for Group Study

ANNOUNCEMENT has been made that the American Bar Association at its next annual meeting is to take up the problem of traffic congestion with a view toward suggestions of legal means of relief. This is an excellent idea. The proposals for congestion improvement involve many nice legal questions, such for instance, as the right of restriction of types of traffic and the redress to ground-floor owners for possible damage by second story streets, to say nothing of the limits to the police power in this new problem. Engineers, however, have much closer interest in traffic control and their societies could well take a leaf out of the lawyer's book. The American Society of Civil Engineers could find no more pressing or interesting subject for one of its annual meetings.

New Cement Possibilities

GRADUALLY emerging from the obscurity of the laboratory and the study the quick-setting high-strength alumina cements are beginning to take on practical importance. The review of their development in Europe by E. C. Eckel, given on another page of this issue, indicates that over there they are beginning to be taken seriously by construction men, which foreshadows a similar progress on this side of the ocean. On account of the nature of their constituents—and especially the concentration in occurrence of the alumina clays that they require—these new cements will never seriously rival the portlands for ordinary construction work. It is obvious, however, that their proved high early strengths make them of the greatest value in certain emergency works where time is the essential quality in completion. For city street work, grade crossings, water pipe repairs, and many easily noted cases, these new cements would be worth the high price they doubtless will require. So far, their other virtue—that is increased safety in saline exposure—is not so well proved, but if proved that too would make them in demand. Mr. Eckel's article intimates an interest in commercial production of the alumina cements in this country. Much remains to be studied in the behavior of these cements, but in view of their promised value, engineers and constructors will hope that the tests and studies now being made will show them to be commercially feasible.

Detours Versus Half-Roads

PROBABLY no car owner will arise to defend detours. They compel him usually to travel a longer way over ill-kept roads whose marking is generally just clear enough to keep him unsure of his course. The detour indeed is generally damned. To avoid it the practice of building only one side at a time has been developed in paving busy roads. By this procedure one half of the road is theoretically always open to traffic. Until one considers it, this practice seems to have very decided advantages over detours. With a little thought, however, and particularly with a little experience in traveling half-roads, there comes the realization that they are one-way routes, that they put a snail's pace on traffic and that they require very cautious driving to clear the construction operations on one side and the ditch on the other side. Indeed contractors can cite more than a few instances when they have had to reset side forms and restore other finished work because a nervous driver in avoiding the Scylla of the side ditch has risked the Charybdis of an irate foreman of form setting. There is no freedom indeed from more serious disaster. The collision near Nyack, N. Y., on Aug. 9, of a motor bus with the boiler of a paving mixer, which resulted in the death by scalding of six of the bus passengers, is an instance to the point. Truly, this was an extraordinary occurrence but it indicates what can happen. Overturning and slewing are the more ordinary risks run by the user of the half-road. They are real hazards and where the engineer and contractor have the alternative of a good detour they should give it careful consideration. Paving half at a time is by no means a universal remedy of the detour evil in road construction.

Making It Work

JUST how many sewage-works in this country do more than provide a mental protection to the citizen and a buffer for the administration against complainants downstream? Not many years ago an Eastern consulting engineer journeyed through the Middle West in winter to see what the best and some of the average plants were doing. Practically every one he visited was out of commission or producing a decidedly poor effluent. Recently state board of health officials have effected some improvements but at the great

majority of small plants there is still much to be desired. Sludge beds are rarely used, reliance being placed on a fortuitous flood which will enable the operator to dump the sludge at the crest. Holes are punched in the beds for the easy passage (by-passage) to the effluent line. Tanks are not cleaned until the passage ways become no more effective than an enlargement in the trunk sewer. A refreshing exception to the above condition was noted in these pages last week, where the mayor of Newton, Kansas, decided to make the plant work and to overcome the difficulty of foaming over the gas vents of the Imhoff tank. Until engineers got to building the vents high and wide, spewing over the top was the rule, excused by the assertion that the foaming would stop when the "plant gets older and better seeded." The way to prevent misuse, non-operation or careless control of sewage-works is to provide better technical supervision, under the direction of state authorities or, better still, by retaining the engineer who designed the plant. Let him make it work.

Joint Operation of Bus and Trolley

FOR nearly a month a large part of the great state of New Jersey, and all of its large cities, have been without street cars. Not so many years ago this would have been an unbelievable situation. Today, thanks to the automobile and the motor bus, business is proceeding with at least superficial regularity and the inconvenience to the public, while doubtless great, has brought forth no wave of protest which a dozen years ago for a similar condition would have forced some kind of trolley service. The situation which has arisen and the tentative moves toward its solution are so indicative of what may be expected before long in street transportation elsewhere that they are worthy of examination.

The Public Service Corporation of New Jersey, in addition to an enormous power and light business, has a practical monopoly on the street railway systems of northern New Jersey, especially in the metropolitan district, which includes the large cities of Newark and Jersey City. For a number of years it has been in the usual controversies with employees and with the Public Utility Commission trying on the one hand to restrict increase in wages and on the other hand to gain increase in fares. It has been operating for some time on an eight-cent fare basis, with one-cent transfer privileges, and with what is generally conceded to have been an exceptionally low wage scale. Matters were brought to a head on the first of August by a complete strike of the employees for higher wages. The company met the strike by the unusual method of shutting down all street car service. No attempt whatever was made to enlist new employees or to operate with such help as could be diverted from other branches of the service. Northern New Jersey was without street cars.

It so happens, however, that this section of the state has been exceptionally well served with motor buses; in fact, it is to these buses that the company ascribes a large part of the difficulties of the railway. Not only were many roughly paralleling bus lines established, but those streets on which were run the busiest and most profitable car lines were taken as bus routes and thus, the railway claims, the buses skimmed the cream of the traffic, running for the most part on a five-cent fare basis. Immediately upon the cessation of the street car service, additional buses began to run, short time licenses were issued, municipal buses of the city of New York were loaned, and private automobiles called into service. So for three weeks the communities went about their business hampered, to be sure, but at least getting back and forth in fair fashion.

Finally, the Public Utilities Commission ordered the railway to restore service and their order was answered by a proposition which marks an interesting point in city transportation development. The railway agreed to restore service only after the acceptance of the proposal which has five main features: (1), the purchase by the railway of all competitive buses at present fair physical value, the railway thereafter to operate both bus and street car systems, as will best serve the public in the judgment of the Public Utilities Commission; (2), the refusal by the cities and the commission of any further competitive bus licenses or franchise; (3), the increase of wages asked by the employees; (4), the acceptance of a certain disputed valuation of the entire railway property by the Public Utilities Commission, and (5), the establishment of a seven-cent general fare for both bus and street car. This proposition was accepted by the employees, but the utilities commission balked on the acceptance of the valuation proposal and on the proposition that the railway could make terms before restoring service. In the matter of the competitive buses a hearing is to be held.

The Public Service Corporation is not loved in New Jersey. Whether justly or not, the people distrust it and welcomed the competition that the buses gave. The general trend of opinion in the state, therefore, would probably be unfavorable to any scheme which would establish for the corporation the natural monopoly in city transportation which their proposal frankly states is inevitable if proper service is to be given. On the other hand, the situation which has developed points toward some such solution as the company proposes. It so happens that the bus development in this section has been so great that the controversy here has arisen somewhat sooner than it has in other parts of the country, but it is merely a feather in the wind to show which way the trend of city transportation is going. Sooner or later a similar situation is bound to arise in practically every congested area. The bus, on account of its flexibility of service, is bound to become a serious competitor of the street railway. On the other hand, the street railway is long established. It has been given certain privileges by the public, in return for which it has expended a vast amount of money, looking toward a long time return. It is not just and, in all probability, it is not legal that the public now should take advantage of the changed conditions, which neither the public nor the railway could have foreseen twenty years ago, to permit another type of transportation to arise and destroy, as it inevitably will destroy if not regulated, the investment of the street railways. The way out seems to be that suggested in New Jersey, that is, the taking over of the competitive bus lines by the street railway, and the operation of the two jointly to the best service to the public.

The advantages of street cars over buses and those of buses over street cars are fairly obvious. They need not be argued. What people are interested in is the best service and not the service of one to the exclusion of the other. They must be operated jointly and effectively and, from an engineering point of view, such operation can best be conducted under one head. There are in-

dications that the trouble in New Jersey is deeper than the mere question of bus versus street car, that the direction of the company has seized upon this crisis to put over its own idea of valuation. Probably the utilities commission will not permit any such solution of the difficulty. But if the corporation is in earnest about its street car trouble, it is to be hoped that the commission will be able to adjust the valuation difficulties in such fashion as to permit the monopoly control of the bus and street railway, so that we can have tested the experiment of this type of street transportation operation. Unfortunately, the public is not today as sure that the commission regulation of transportation will insure as good service as will competition, but it seems only fair that the theory should be tried out. The commission has the opportunity now to gain agreement to some arrangement with the railway company whereby the railway will be permitted to show the public how good service it can give by joint operation and in which, also, the commission will have full power to maintain proper service.

An Experiment Worth Trying

ENGINEERS and engineering societies use up a great deal of useful time discussing professional ethics, but they take very little real action which will lead to an improvement in practice. Codes continue to be written and interpreted as generalities, but specific cases in violation are either shrouded in the cloak of anonymity under which the offenders are invisible, or they are used merely as text upon which are written virtuous homilies. Last spring, for instance, an effort was made by the Board of Direction of the American Society of Civil Engineers to inaugurate a more personal application of code violations, but the conservative view characteristic of that society continues to prevail and the impersonal application of ethics remains as before. One can well recognize the difficulties in a more strenuous treatment of this ethics problem, but it is hard to escape the impression that the delicate way in which most societies handle code violations put most of the members in the position of fearing to cast the first stone. Some day some society is going to have the force and courage to take up the situation more vigorously. From that time professional ethics in engineering will begin to be elevated.

Just at present two specific cases of a practice in violation of code offer a suggestion as to how such things might be treated. Each of these cases is an illustration of the way too many cities are going about getting engineering service. In the first, the Board of Water Commissioners of a certain Eastern city, sent out letters to a number of engineers inviting them to submit a proposition covering a complete engineering report on a proposed water supply for the city. The details of the information required were supplied and the engineers were asked to bear in mind that the city wanted the best solution of the water problem and to furnish bids to cover the cost of making the investigation and of preparing plans in shape for decision by the State Board of Health. Thirteen bids were received on this advertisement and the contract awarded on a lump sum basis for the engineering work of investigation and for the engineering work of construction, without regard to the total amount of work that might be required either in investigation or construction.

In the second case, a certain city advertised for competitive sealed proposals from "experienced engineers for preparing preliminary plans and specifications and furnishing estimates of the cost for a modern power plant." The bid was asked as a lump sum and, in addition, engineers making the bids were asked to furnish a bond "for such engineering service." No indication was given as to the use to which such a bond would be put, but it is quite probable that it would be used by the authorities to assure the tax payers that they were receiving proper service and advice.

Both of these are illustrations of a common enough practice. Obviously it is in violation of a proper code of engineering ethics. Probably it is not illegal, but it cannot tend to good engineering because the extent and cost of a true professional investigation cannot be estimated. The consequence is a chance of lower standard of work and the selection of engineers who are willing to cut prices, but whose professional equipment cannot be guaranteed. It is not only detrimental to the engineering profession, but it is dangerous to the community.

The practice, however, will not be cured by individual complaint nor by society generalizations. That has been proved. There have been many such complaints and many such generalizations and the practice continues. It would certainly be an experiment worth trying for some society which has cognizance of a similar performance, and such performances are continually available, to attempt a new line of action. As soon as a city makes public such an offer let the society or the local chapter thereof take a page in the local newspaper noting the case and reviewing the reasons against it. This advertisement, of course, must be dignified and sufficiently authenticated to relieve any of the members of the society from the charge of self interest. It should not be published until after an argument by the society with the city officials had proved unavailing. If the city persists in its advertising after the notice by the engineering society and accepts bids, let the society then issue a second advertisement in which the names of the engineers who have bid are specifically mentioned with appropriate comment regarding the possibilities and probabilities involved in the whole transaction. If there is anything at all in the force of public opinion, or if there is any such thing as public respect for the engineering profession there will be few city administrations that would dare to go through with this advertising for engineering services after such a campaign by the representative engineers of the community.

It is recognized that any local society will probably contain in its membership certain of the engineers who will participate in such a competition. It is the privilege of these engineers to vote in open meeting on the desirability of the society entering into an open campaign against the practice of bidding for engineering services, but having spoken they have no redress in law or in ethics for public chastisement by their professional brethren provided always that these brethren have not themselves in the past participated in similar practices and are thereby disbarred from criticism.

Such a procedure would be in definite opposition to anything that has ever occurred. There should be somewhere, however, a group of engineers with sufficient courage to take up such a definite stand in specific defense of what every engineer will admit is a proper attitude of mind.

Building New Argentine-Chilean Transandine Railway

New Transandine Line Has American Viaducts and Equipment—Maximum Grade 2.5 Per Cent—Uses Switchbacks and Spirals—Tunnels, Cut-and-Cover Work—Summit 14,681 Ft.

By Richard F. Maury
Chief Engineer of the Salta-Chile Extension,
Argentine State Railways

A SOUTH AMERICAN railway development which should mean much to the United States and which will probably cause important changes in trade routes, besides opening a rich section of country, is the Salta-Chile extension of the Argentine State Railways, now under construction, to connect the existing railway system with the Pacific port of Antofagasta. This work, after being under consideration for many years, was undertaken by the railway administration in March, 1921, work being started in May of the same year. Views on this Transandine section of a new transcontinental line are shown in Fig. 1.

The object of this line is mainly the development of the northwestern provinces of Argentina, which are little known and are practically isolated by the great distance from Atlantic ports. These provinces comprise one of the most promising regions of the world for extensive development, since this region offers a great variety of climate, is watered by numerous rivers and is capable of producing practically everything grown in tropical, sub-tropical and temperate zones. In addition to this, the completion of the line will undoubtedly affect the relations of the United States with Argentina, as a large part of the imports through the ports of Buenos Aires and Rosario de Santa Fé will probably seek this new and shorter route. By sea the saving in distance to America and Japan is striking, as shown in the following computation. The distance to European ports is but slightly increased by the new route, while relations with North America will be greatly facilitated.

To	From Buenos Aires Miles	From Antofagasta Miles
New Orleans	6,260	3,419
San Francisco	8,640	4,600
New York	5,838	4,011
Tokio	12,100	9,300

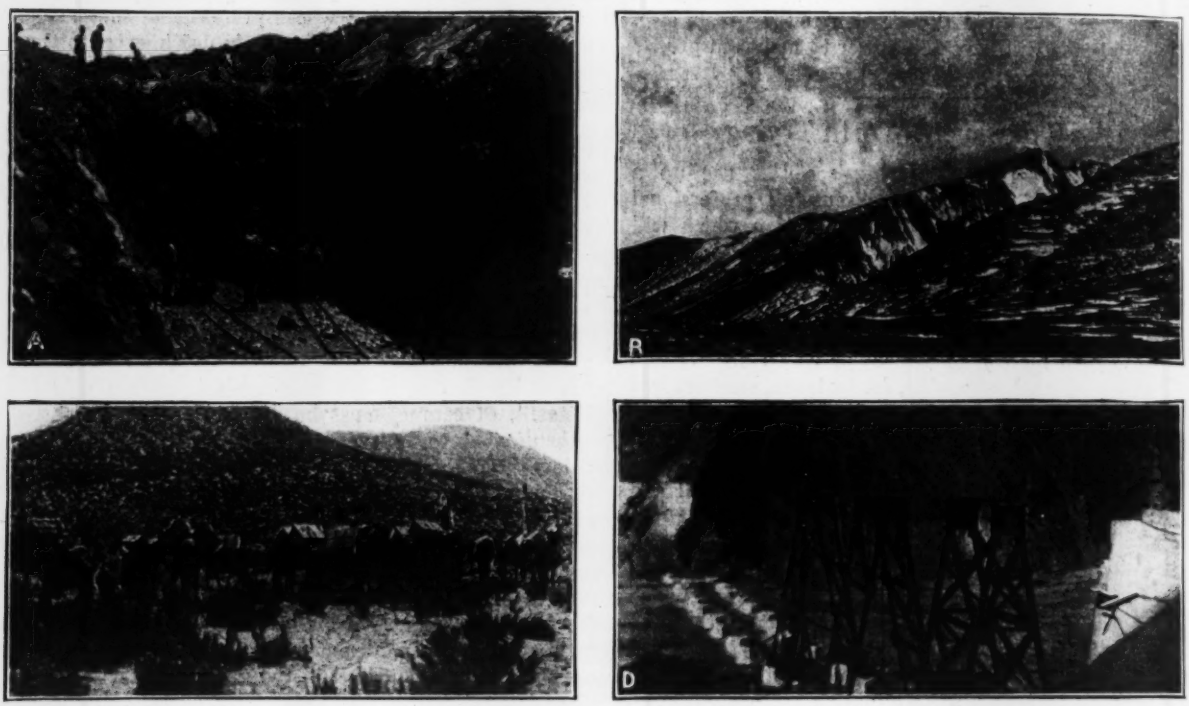


FIG. 1—VIEWS ON NEW TRANSANDINE RAILWAY
A. Heavy rock grading by hand at K. 150. B. The Chani Pass, near line, El. 21,000 ft. C. Mule-team with dynamite for tunnel at K. 180. D. Typical viaduct.

Route and Profile—With a total length of 492 miles from Salta to Antofagasta this meter-gage railway will have 320 miles in Argentina and 172 in Chile, the new construction being about 300 miles and 75 miles respectively. As shown by the map in Fig. 2, the line leaves the existing branch of the State Railways at Rosario de Lerma, 18.6 miles from the city of Salta. Between these points track has been relaid and heavily ballasted to put it in condition for handling the new rolling stock. From the junction, 4,370 ft. above sea level, the line begins its climb on maximum grades of 2.5 per cent, through the gorge of the Toro River, which is followed to Km. 74 (mile 46). The first reaches of this section presented considerable difficulty as the grade of the river bed exceeds 2.8 per cent, the difference

being saved by two switchback sections. Maximum grades are continued, with some easier portions, to the first summit in Abra Munano which is reached in Km. 142 (mile 88) at El. 13,264 ft.

The climb out of the Toro gorge at Puerta de Tastil

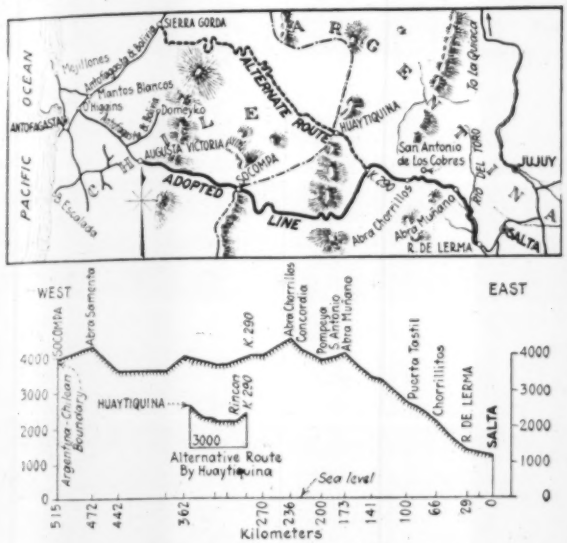


FIG. 2—PLAN AND PROFILE OF ARGENTINE-CHILEAN RAILWAY

is the most interesting feature of this long ascent, recourse having been had to some very heavy development, including two spirals, as shown by Fig. 3. Practically all the difficult part of the construction is comprised in the stretch between Rosario de Lerma and Abra Munano, which is passed with a tunnel about 1,000 ft. long. After traversing some 12½ miles of undulating plain to arrive at San Antonio de los Cobres, capital of the Andes Territory, the line again begins to climb and crosses the Abra de Chorillos, in open cut, at El. 14,681 ft. and a distance of 124 miles from Rosario. Between San Antonio and the Abra de Chorillos the important Concordia mine will be served by a station alongside the pit.

At the Abra de Chorillos the line, after a slight descent, enters on the plateau of the Puna de Atacama which is traversed with only surface work and with very easy grades until the frontier is approached, where 12½ miles of heavy cutting bring it to Socompa on the continental divide, some 310 miles from the start and at El. 12,989 ft. Crossing the plateau, there will be some very long tangents, the longest being 43½ and 25 miles, both completely level. From the frontier the line in Chilean territory will run around the Domeyko range to connect with the terminus of the existing railway of 30½-in. gage at Augusta Victoria, an important nitrate deposit, at El. 5,871 and 95½ miles from Antofagasta.

An alternative route, originally proposed, was to cross the frontier at Huaytiquina and connect with the Antofagasta & Bolivia Ry. of 30-in. gage at Sierra Gorda (see Fig. 2). The total distance by this route was 564 miles from Salta to Antofagasta, including 202 miles of new construction in Argentina, from Rosario to Huaytiquina, and 238 miles in Chile, from Sierra Gorda to Huaytiquina. By the adopted route the total distance is only 492 miles from Salta to Antofagasta, with 375 miles of new construction.

Climate—Climatic conditions on the first sixty miles of the new line are extremely unfavorable, the rainfall being very heavy during the summer months (December to March). Floods are frequent in the rivers and have made necessary the construction of massive protection walls and retaining walls to protect the line against bank erosion and landslides which are facilitated by the very loose character of the soil. The rains of this year have been of exceptional nature and have served the very useful purpose of demonstrating that the provisions made for the protection of the line are ample and that little difficulty is to be anticipated on this account.

In the higher reaches of the line, the precipitation is very light and there will be no difficulty from snow, as the only district where snowfall is appreciable is in open claim where drifts do not form. Above El. 9,840 the country is barren, but some vegetation (sage and greasewood) is found as high as El. 15,744 ft. and in sufficient quantity to serve as fuel for the grading gangs. The topography is very broken as far as Km. 200 (mile 124) where the undulating plain of the Puna begins.

Grades and Switchbacks—Grades have been kept down to 2.5 per cent throughout and are compensated for curvature, the compensation on curves of minimum radius, 492 ft. (150 meters) being 0.04, bringing the profile grade down to 2.1 per cent.

Curvature is extremely heavy, averaging 133 deg. per kilometer (200 deg. per mile). Tangents aggregate 52 per cent of the total line.

Switchbacks have been found unavoidable in two cases, but are short (2,624 and 3,938 ft.). Both of these are shown in Fig. 5. The tail tracks are 1,190 ft. long, laid out on easy vertical curves and having the ends covered with sand to check trains that may be run too far. The construction of the tail tracks has required in one case the introduction of a 230-ft. tunnel and in the other a small viaduct. Both switchbacks are located at stations, thus reducing the number of halts to a minimum and permitting the station force to look after the operation of the switches.

Bridges and Viaducts—Many important bridges and viaducts are necessitated by the crossing of numerous lateral valleys (see Fig. 1). Viaducts are of the general American type with steel towers on concrete pedestals, the tower spans being 32.8 ft. long and the

FIG. 4—RIO BLANCO STATION AT ENTRANCE TO TORO GORGE

plate girder spans between towers being generally 65.6 ft. Bridge steel is supplied partly from the United States by the McClintic-Marshall Co. and partly from Germany by the Krupp and the Guttehoffnungshutte concerns. Preference has been given to plate girder

construction with trough flooring and all small culverts have solid reinforced concrete floors. Bridge erection so far has been done by local contracting firms, but it is proposed to build some of the larger viaducts ahead of rail by giving the contracts for the erected structures to responsible and experienced firms.

Tunnels and Slide Protection Works—Tunnels will be twenty in number, varying in length from 230 ft. to 1,542 ft. They will be in all classes of material, from loose sand to very hard granite. Typical sections are given in Fig. 6. Complete drilling and compressor machinery has been supplied by the Ingersoll-Rand Co., but many of the tunnels are being excavated by hand. As a general rule the European contractors prefer the top heading method of tunneling, but some tunnels in harder material are being excavated by the usual American system.

In one case the character of the formation has given rise to a very serious difficulty. After completion of the lining the whole side of the mountain (in very badly shattered clay schist) sloughed off, the line of fault passing close to the springing line of the arch, and causing deformation of the lining (16 in. thick at the crown) due to the eccentric thrust of the slide.

To protect the line against slides it has been found advisable to build some 400 ft. of "cut-and-cover" tunnel (Fig. 6), but it is probable that experience will demonstrate the necessity of greatly increasing this figure. In one case the line crosses under a considerable affluent of the Toro in cut-and-cover, as it was found impossible to construct a bridge over it without loosening the support on the sidehill slope.

In the zone of heavy rainfall many heavy retaining walls have been built to protect the line against slides. All walls are of the gravity type. Toes of banks subject to flood attacks have been protected by defence walls. The Toro is the only river that has required work of this class, which has been limited, as far as possible, by carrying the line well up on the slopes beyond the action of the river. In most places bank protection has been carried out in concrete or rubble masonry, but where the action of the river is not particularly to be feared, "sausages" of stone wrapped in woven wire are used with excellent results.

Masonry defence walls at the toes of embankments are constructed with short spur walls or groins at right angles with the main wall, as shown in Fig. 7. These spurs are about 33 ft. long and 66 ft. c. to c. The author's experience of many years in this region has demonstrated the absolute necessity of providing the spur walls to avoid scour and undermining along the main wall.

Shops and Yards—Large shop plants and engine terminals are not required, in view of the proximity of the State Railway shops at Tafi Viejo. The roundhouse at Salta (which will be the starting point for all trains) will be enlarged and put in condition to handle the heavy locomotive equipment.

Temporary shops for construction purposes at Quijano, six miles from Rosario, are equipped with machine tools, oxy-acetylene and electric welding plants and everything necessary for the repair of the locomotive and motor-truck equipment.

Construction Plant—Two 70-ton Bucyrus steam shovels will be put to work for ballast and bank widening, using the American-built standard 30-ton side-and-

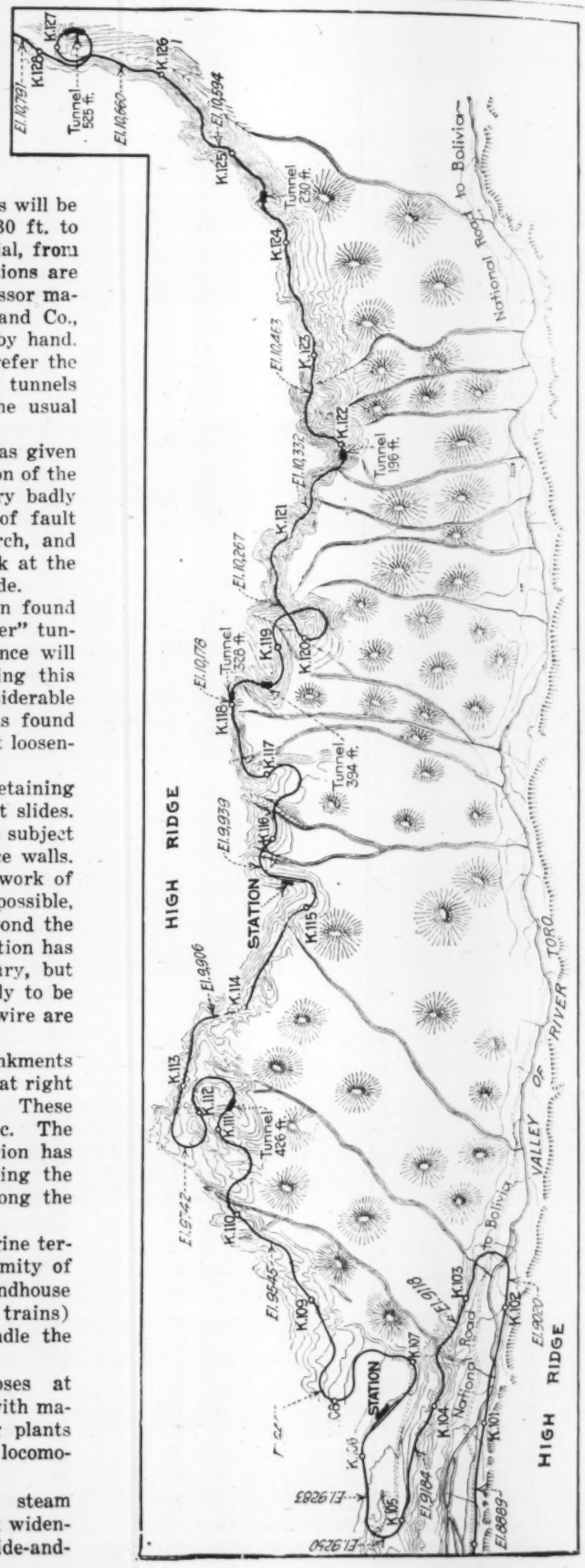


FIG. 3—DEVELOPMENT IN CLIMBING OUT OF TORO RIVER GORGE
Showing the two spirals and many loops used in gaining height at the expense of distance. In this section

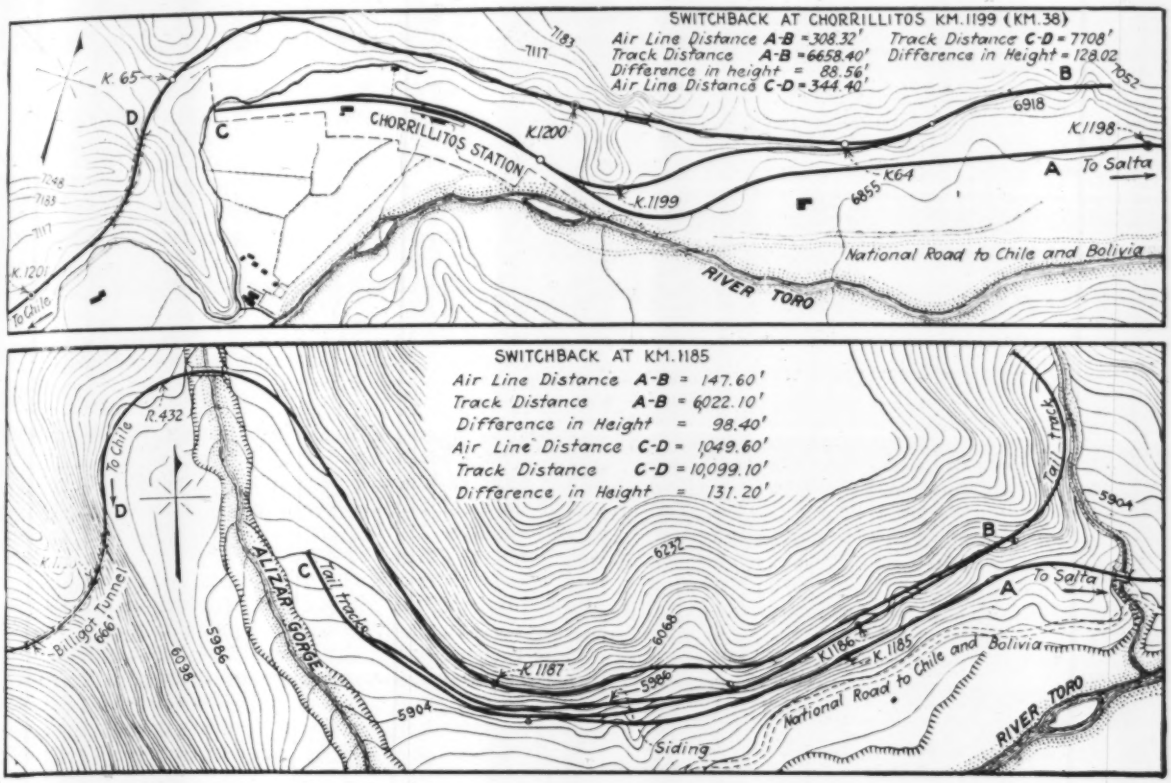


FIG. 5—SWITCHBACKS ON NEW TRANSANDINE RAILWAY

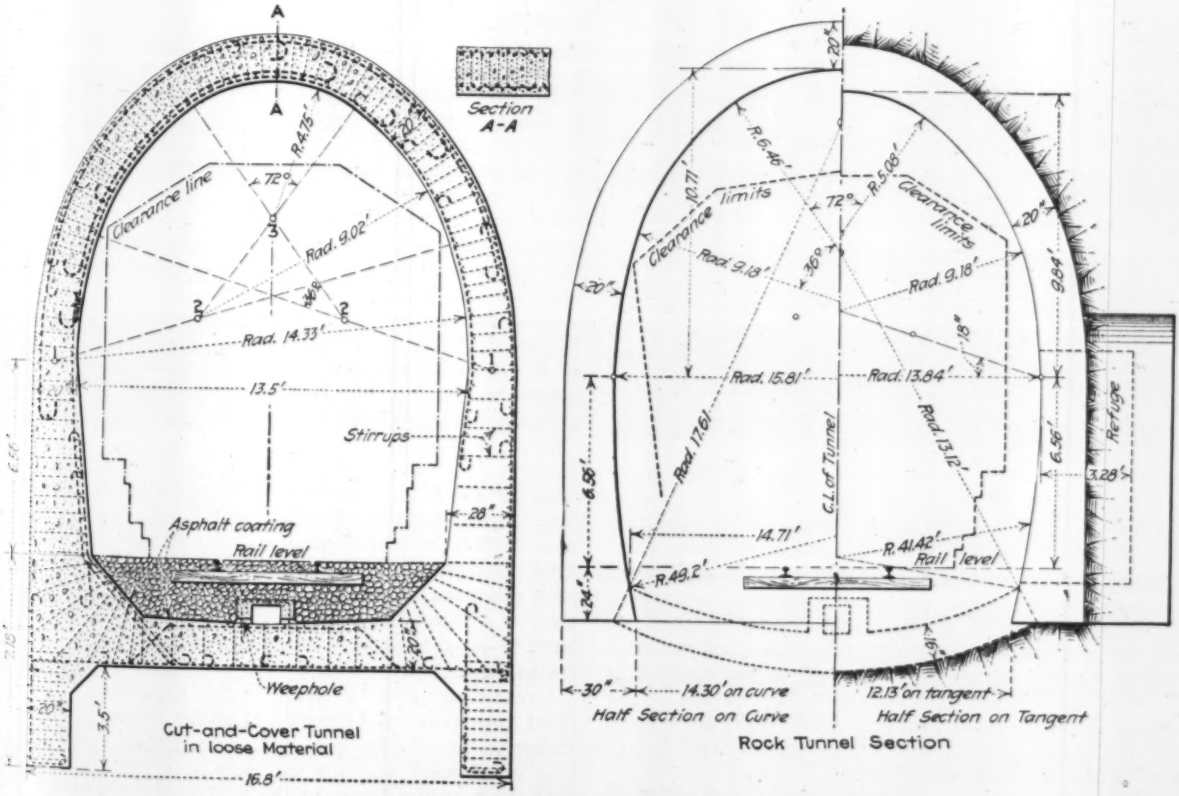


FIG. 6—ROCK TUNNELS AND GALLERIES IN LOOSE MATERIAL

center dump cars built for the State Railways by the Rodgers Ballast Car Co. and the Middletown Car Co. Earthwork has been attacked about 100 miles beyond the rail-head, supplies being carried in by carts and motor trucks. Practically all bridge and culvert masonry has also been completed ahead of rail.

Labor Conditions—All skilled labor is European or Argentine, there being practically no Americans in this part of the world. The peons are mostly natives from the hill country, Bolivians and Chileans, no others can stand the work in the high altitudes. Even with labor accustomed to the conditions, mountain sickness is very common.

Contractors pay by piece work, treating with the

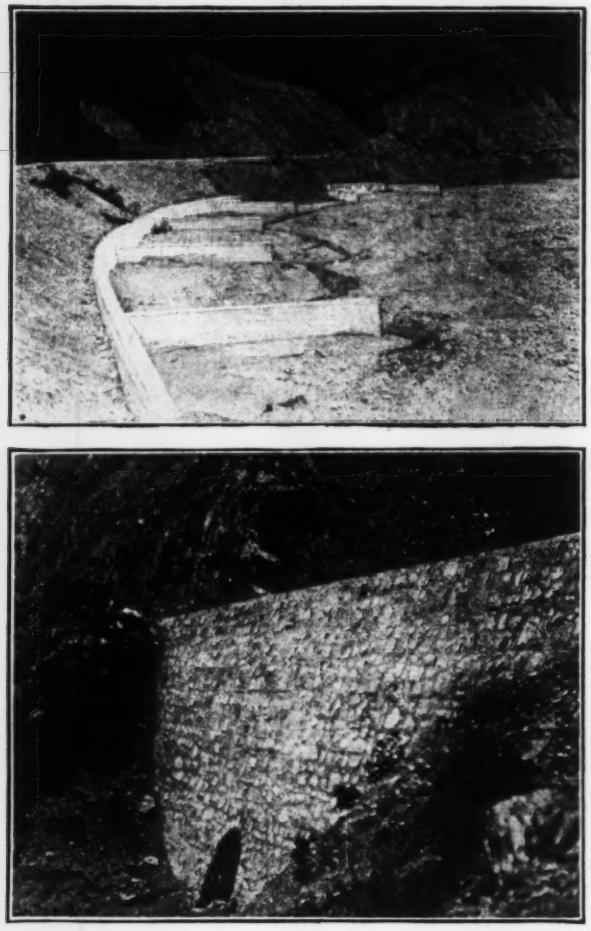


FIG. 7—MASONRY WORK ON TRANSANDINE LINE
Above: Concrete wall and groins protecting railway bank from flood erosion.
Below: Stone wall 45 ft. high to hold fill across ravine.

head man of each group of workmen. Working hours for men on the Administration force account are eight hours a day and the average daily pay the equivalent of $2 U. S. gold.

Engineering Staff—For construction the work is divided into sections (five at present), each under a sectional engineer with a full staff of assistants and inspectors. Each section is responsible for the laying out, inspection and payment for all work, as well as for the requisitioning and supply of material to the contractors and company forces.

Six survey parties are in the field, each chief of party reporting directly to the chief engineer. In difficult country, all surveys are revised by a second party, where possible, to avoid errors of omission in grasping the possibilities of the country.

Progress—The rail-head on Feb. 1 was at Km. 70 (43½ miles from Rosario de Lerma); earthwork was contracted and practically finished up to Km. 140 (mile 47) and was well under way out to Km. 200 (mile 124). No work had been contracted ahead of this point. Advance of the rail-head will be delayed for some months by uncompleted tunnel work, but should reach San Antonio early in 1924. Work from Socompa eastward, on Argentine territory, will be started shortly and it is hoped to have the rails at the frontier by 1926.

Work on the Chilean section has been limited to surveys, but a diplomatic agreement between the two governments will require construction to be started at once. This agreement has yet to be ratified by the Chilean Congress. The work to be done in Chile is comparatively light, consisting of the construction of about 74½ miles of line and reconstructing to meter gage the 95½ miles of 30.4-in. gage from Augusta Victoria to Antofagasta.

Track and Signals—Track on the Argentine section is being constructed in a very substantial manner. Rails are 75 and 80 lb. per yard, laid on red quebracho ties 4.8 x 9.6-in. and 6.56 ft. long, with 2,400 ties per mile. The roadbed is heavily ballasted with broken stone or clean river gravel and has liberal ditching. All stations will be protected by home and distant signals. Train movement will be controlled by the absolute staff system and in addition the Western Electric Co.'s system of train control will be installed at all stations. The operation of trains through the switchbacks will be protected by electric interlocking, while all main-line switches will be equipped with mechanical interlocking, working in conjunction with the signals. In short, the line will be put in condition to handle an intensive traffic efficiently.

Equipment and Traffic—Locomotive equipment includes ten Baldwin engines of the 2:10:2 type, six 4:8:2 and one 2:8:2. Those of the first two types are oil burners and are the most powerful locomotives in use in the Argentine Republic. The equipment includes sixteen motor trucks of 4- and 7-ton capacity and eighty cars of different types, but mostly flat cars. This equipment is supplemented with some 160 six-mule carts and a large number of pack animals.

This railway project is the most ambitious that has been undertaken in South America, limiting conditions of grade such as are here employed never having been attempted in crossing the main chain of the Andes. But the additional cost due to the low grades will be amply justified by the reduction in cost of operating. Freight traffic in sight, discounting increase due to opening up a rich country, is estimated at 478,000 metric tons annually, of which 220,000 tons is eastbound and 230,000 tons westbound and 28,000 tons local business. Passenger traffic will require a daily train in each direction. As the capacity of the 2:10:2 locomotives is 460 tons on the maximum grades, the line will have to provide at once a service of four or five daily trains in each direction.

Great credit must be given to the Argentine Government authorities and the officers of the Argentine State Railways for the courage with which they confronted this great work and for the way in which they have kept the working forces in the field supplied with materials and money in face of much opposition.

Notes on the French Industrial Situation

By Our Paris Correspondent

THERE IS but one compelling influence which dominates French economic, industrial and financial spheres today: the necessity for stabilization.

The most urgent reconstructions in France have been undertaken and for the most part carried to completion in the devastated regions where, on June 30 last, 7,875,000 acres out of 8,250,000 acres had been reclaimed and restored to cultivation, 20,000 factories out of 22,900 rebuilt and "reorganized," and 590,000 dwellings rebuilt out of 741,993 destroyed. The population of the invaded districts is today but 400,000 below that of pre-war figures and is already paying taxes to the government of 3 billion francs a year, whereas in 1920 the figure was but 600,000,000 francs.

Building costs are the obvious deterrent from a more intensive construction campaign of the moment, less so with respect to materials than to labor. In spite of this the very necessary reconstruction of the devastated regions, as well as the delayed public works which were left stagnant during the war period, have made a demand for most lines of raw and semi-fabricated materials such as was never before known.

Cement Demands—In so far as this has affected the portland cement industry recent reports of four leading French manufacturing companies are pertinent as to facts and figures showing the present value of such industrial property. Before the war a metric ton of portland cement sold in France for 30 to 35 francs; soon after the armistice it was quoted at 280 francs and today at an average figure of 115 francs, rising to 125 francs in some districts. The before-the-war price was nominally $7 per ton at the then ruling rate of exchange; that of today (with a six-cent franc) about the same in case the product was bought with American cash by some American firm operating in France, but at a figure which is three and a half times that if the purchaser is a Frenchman buying with francs. This comparison shows the anomalous state of affairs which the American often ignores in quick estimates of the situation in France today.

A. Antoine, of the Bureau des Ponts et Chaussées, upon return from a recent visit to the United States made a report to the Comité Michelin d'Organization Rationalle and the Syndicate of Public Works Contractors, presided over by Monsieur Michelin, the automobile tire manufacturer, on his observations of the comprehensive and elaborate road building being carried out in America.

The mere mention by M. Antoine of 79,000,000 sq.yd. of concrete roadway having been laid in the United States in 1922—7,480 miles of an 18-ft. roadway, or the equivalent of almost the entire length of the Routes Nationales of the first class in France, was received with appalling silence. The next step was to find the ways and means by which this progress might be equaled in France There was the difficulty. Taxation in all its forms on automobile road users in particular, has reached the limit of tolerance. Above all he argued for the use of concrete as being the material which gave the best results in meeting an intensive light and heavy automobile traffic such as is at present being imposed upon the *macadam* and *tresaguet* French highways, which they were never intended to stand up under. His statement that such a road surface would, if properly laid as in America, last twenty years with a low maintenance cost was especially well received by the French authorities who well recognize the necessity of adopting some rapid and efficient measure which shall lift French roads out of the slough into which they were fast falling. It is claimed that all the raw material required for such roads can be found within the French frontiers. It is doubtful if the same can be said of the new machinery which will be required. For many kinds of modern machinery adapted to uses which were formerly carried out by manual labor, France is still dependent upon the outside world.

Housing Progress—Various organizations in France, without any specific government encouragement, are occupying themselves with low-priced dwellings for an ever increasing suburban population as distinct from town dwellers or the purely rural population. Italy, on the contrary, through a government department is actually offering financial aid to private enterprise in this direction. Belgium has a government-controlled standardization bureau where building materials of various kinds are offered at a "standardized" price.

In France private initiative alone has been able to show a homeless and home-desiring public—first by necessity in the devastated regions and later in suburban Paris, Bordeaux, Lyons and Marseilles—how to build a modest dwelling in a third of the time ordinarily required and at half or two-thirds the cost of construction by old methods. The following prices are quoted for the construction of small dwellings for workingmen in the Paris district:

	Two-Room	Three-Room	Four-Room
	(Prices in Francs at $0.06)		
Wood chalet	6,000	9,975	.....
Staff construction	5,940	8,335	.....
Wood and plaster	6,400	9,770	12,500
Agglomerated slag brick	7,950	11,150	17,000
Compressed cement blocks and binder (System Charpentier —Etablissements Charpentier, 188 Boulevard St. Germain, Paris)	5,900	8,500	11,400

Some fifty-odd structures after the last mentioned method (compressed concrete blocks with a cement binder forced into the joints under pressure) have been erected by this firm, which abandoned a long traditional career to espouse this new idea of fabricating the modest cottage home at a lower figure and in a more solid manner than was known before. The figures translated into dollars, $360, $510 and $684, respectively, are certainly cheap. The owner's handkerchief-plot of land may well be had for the equivalent of another $150 within ten miles of the Paris fortifications. Here, perhaps, is the solution of a big economic problem.

Not wholly unrelated to the above project is that of the city of Paris which proposes, by competition, to erect a series of workers' tenement buildings. The plan is for the moment checked by reason of the attitude taken by the Society of Federated Architects. When it was learned that the project was to be carried out by four *salaried* architects whose designs should be accepted, a protest was made to the effect that such an arrangement would be the "reduction of a high class profession to that of a mere city employe without position or dignity or proportional honoraria." There the matter stands. The French are like that—sometimes.

Metal Production—Aside from the wholly enviable situation of France as a self-producing country in most things of the table its prime position in metallurgical affairs is what gives, or will give, it a predominant influence in European metal markets. Indeed, the part that France is likely to play in the export metal market, even to structural steel shapes and almost everything except wire, plates and sheets, can hardly be estimated as yet in view of the liquidity of the situation. Certain well-informed French "journals of opinion"—not what we know as newspapers, be it remarked, but printed sheets which are all potent in France—are daily urging an association of Ruhr and Lorraine metallurgical interests to control the combined output of the two contiguous regions, a plan which, if followed, will combine to make the most formidable iron and steel and allied industry—trust, consortium, call it what you will—in the world. The proposition is not without a logical backing. The ways and means have yet to be provided but there is an undoubted disposition on the part of many French and German elements tending toward this as a possible solution of a problem which is daily becoming more and more obscured by outside issues.

As to the possibility of France becoming a world factor in metallurgical affairs the following figures eloquently point the way:

FRENCH EXPORTS, FIRST SIX MONTHS, 1923

	Francs
Pig iron	128,897,000
Ferro-alloys	10,221,000
Semi-finished and finished iron and steel products	555,378,000

FRENCH EXPORTS TO UNITED STATES DURING ONE MONTH OF 1923

	Francs
Pig iron	3,950,000
Iron and steel products	1,440,000
Machinery and parts	1,378,000
Tools and manufactures of metal	1,424,000

Employment—That the French workingman, whatever be his trade, is well occupied is shown by the figures of the French Foreign Labor Bureau for the week of July 30 to August 4. There were actually placed 5,677 foreigners, including 2,307 Poles, 1,925 Italians, 511 Belgians, 239 Spaniards, etc. Of this number the iron mines took 85, coal mines 239, navvys accounted for 439, building trades 956, laborers 1,115, agricultural laborers 1,655, etc.

The trades union authorities in France have recently opened a "consultation" as to the actual operation of "workers' councils," or shop committees, where they have been introduced. This movement shows with what precision of detail the communists, the French political party, with representatives in parliament, with which the movement is associated, are studying the ways and means of replacing the power of the employer and capitalist at some future day with some species of sovietic regime and organization. It seems almost futile that they should hold out for any such solution in France, for the country and its people are by intent, preference and tradition wholly against interference with individual rights, among workers as among others.

Transportation—One of the biggest canalization jobs ever undertaken in western Europe is about to come into being in making the River Rhone navigable between France and Switzerland—Lyons in mid-France to Geneva at the western end of Lake Leman. France, in order to be sure of a sufficient water supply at all times, insists that Switzerland shall first raise the level of Lake Leman. Switzerland claims that this would prove a real inconvenience to river property owners and dwellers on the shores. At the last meeting of the International Rhone Conference the Swiss delegates demanded that Swiss barges and canal boats should be free of French taxes on their voyage from Geneva to the Mediterranean, the proposition being rejected or ignored by the French delegates. The reply of Switzerland was to protest that the level of Lake Leman could not be raised.

A big lock is to be built at Genissat between the Swiss frontier and Lyons and a great distributing port just outside of Lyons down-river. The entire work is merely under discussion and economic and political interests are at work to block it in favor of a direct railway from Switzerland due west to the twin ports of Nantes and Saint Nazaire, where there remain the embryonic port facilities which were elaborated by the American army in France and which can care for a far more considerable traffic than France alone can feed to them. One or the other or both these projects are bound sooner or later to come into being but financial matters and international common accord are yet to be reconciled.

The channel tunnel between Calais and Dover has come again on the tapis these last days but the French interests have manifestly not the available capital to put into it and British interests are still discussing the possibility of a tunnel being a danger to Great Britain in case of war. Real or fancied bogeys like these are what are holding back the progressives in France.

The already decided electrification scheme for French railways is one aspect which has not suffered from a like lethargy and both the Midi and the Orleans railways have already begun the erection of hydro-electric plants which in from five to ten years will give electric power for the running of trains over the greater part of the minor lines of their respective systems.

Lighthouse Power Increases in 2,600 Years

In describing the new 3010 candlepower harbor light for Port Said, *Engineering*, a British publication, states that: "To Egypt belongs the credit of the erection of the first lighthouse on record, namely, the tower built on the island of Pharos at the mouth of Alexandria Harbor, about 660 years before the Christian era. This tower was 100 feet high and stood as a monument to an ancient civilization until the fourteenth century when it was washed away by the sea. Its light consisted of an open fire of burning wood, and the same practice was followed in all subsequent lighthouses until the beginning of the seventeenth century. Even as late as 1790 the South Foreland lighthouse was merely a beacon fire of coal. The famous Eddystone Lighthouse, in 1759, was lighted by 10 lb. of tallow candles, a clock being provided to ring a bell every half-hour to remind the keeper to snuff them. In 1763 oil lamps with reflectors were used for the lighting of the Mersey Channel, and after the invention of the Argand burner twenty years later oil became the standard illuminant. Mineral oil was introduced in 1872, and the concentric wicks of the Argand burner in due course gave way to the incandescent mantle, which now furnishes light for all the most important lighthouses of the world."

Trapezoidal Portal and Eccentric Heel-Joint of Truss

BY CAMILLO WEISS
Bridge and Fabrication Department, Bethlehem Steel Co., Bethlehem, Pa.

ANALYSIS of statically indeterminate structures is usually laborious and time-consuming unless formulas are available. On the other hand the value of ready-made formulas depends on the exactness of premises and the reliability of typography, both of which should be checked by the discriminating user. A formula well understood is usually of great advantage as to speed and accuracy in practical application. Formulas are therefore given in the present article for a frequently occurring case, namely the trapezoidal portal carrying an unsymmetrical load. This type of structure is encountered more frequently than will be recognized at first sight. It is of common occurrence in the eccentric heel-joints of roof trusses.

Looking back only eight years, the heel-joint problem received considerable space and attention in the technical press, and brought forth some astonishing solutions. Finally, a graphical method was offered by Prof. E. H. Rockwell, in *Engineering News* of Oct. 21, 1915, which implied certain assumptions similar to those underlying this analysis, and which is in good agreement with the analytical method presented in the following discussion.

The relations given below were derived by the slope-deflection method which is described in detail in "Analysis of Statically Indeterminate Structures by the Slope Deflection Method," by W. M. Wilson, F. E. Richart and Camillo Weiss, Bulletin 108, Engineering Experiment Station, University of Illinois.

Trapezoidal Portal—For the portal in Fig. 1, hinged at C and T and carrying a load of R lb., the following relations may be established when deformations due to shear and to direct stresses are neglected:

Bending moment at A, in in.-lb.,

$$M_A = Rl_1\left(1-\frac{l_1}{p}\right)\frac{\frac{l_1}{I_1}+\frac{3l_3}{2I_3}}{\frac{l_1}{I_1}+\frac{l_2}{I_2}+\frac{3l_3}{I_3}}$$

Bending moment at B, in in.-lb.,

$$M_B = Rl_1\left(1-\frac{l_1}{p}\right)\frac{\frac{l_2}{I_2}+\frac{3l_3}{2I_3}}{\frac{l_1}{I_1}+\frac{l_2}{I_2}+\frac{3l_3}{I_3}}$$

Reactions and direct stresses, in lb.,

$$C = R\frac{l_1}{b}; \qquad T = R\frac{l_1}{a};$$

$$H_1 = \frac{M_A}{l_1}; \qquad H_2 = R\left(1-\frac{l_1}{p}\right) - H_1$$

In these formulas I_1, I_2 and I_3 are the moments of inertia of the respective members, and l_1, l_2 and l_3, a, b, and p are lengths, in inches, as indicated. It will be noted that the sum of the two moments is

$$M_A + M_B = Rl_1\left(1-\frac{l_1}{p}\right)$$

This equation, which may be obtained directly from the static conditions of equilibrium, shows that the sum of the two moments is independent of the shape and area of cross-sections. It approaches zero as l_1 approaches p, and equals the quantity Rl_1 if p becomes infinity, and the portal rectangular. This is exactly as should be expected.

Eccentric Heel Joint—The above derivations are immediately applicable to the eccentric heel joint of a roof truss, shown in Fig. 2. The direct stress in the top chord is $C = R\frac{l_1}{b}$, and the direct stress in the bottom chord $T = R\frac{l_1}{a}$. The quantity $\frac{l_3}{I}$ is relatively so small that it may be neglected for all practical purposes, simplifying the equations to

$$M_A = Rl_1\left(1-\frac{l_1}{p}\right)\frac{\frac{l_1}{I_1}}{\frac{l_1}{I_1}+\frac{l_2}{I_2}}$$

and

$$M_B = Rl_1\left(1-\frac{l_1}{p}\right)\frac{\frac{l_2}{I_2}}{\frac{l_1}{I_1}+\frac{l_2}{I_2}}$$

For flat roofs the difference between l_1 and l_2 may also be neglected, furnishing the very simple formulas

$$M_A = Rl_1\left(1-\frac{l_1}{p}\right)\frac{I_1}{I_1+I_2}$$

$$M_B = Rl_1\left(1-\frac{l_1}{p}\right)\frac{I_2}{I_1+I_2}$$

In all cases the moments at F and G are found by the expressions $M_F = H_2 l$ and $M_G = H_1 l$.

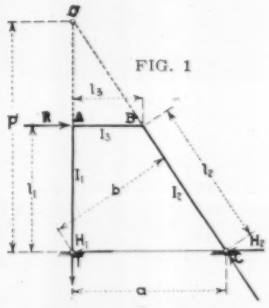


FIG. 1

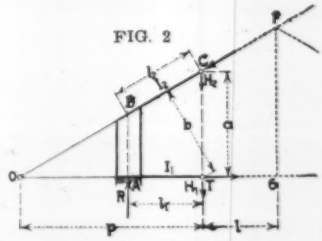


FIG. 2

DIAGRAMS FOR MOMENT FORMULAS

Nothing has been said so far to fix the location of the points of contraflexure, except that their relative position is implied to be in a vertical plane. The actual location of points C and T will depend on the relative degree of restraint at points A, B, F and G. If points F and G were pin-connected, which assumption underlies all truss analyses for primary stresses, l would be zero, point C would coincide with point F, and point T with point G. If the restraints at A, B, F and G are of equal degree, the points of contraflexure are at the centers of the members AG and BF respectively. Special conditions in any given case will influence the location of the points of contraflexure and require the judgment of the engineer.

Assuming contraflexure at the mid-points, the bending moments at A, B, F and G will be greatest when the end panel is about six-tenths of the full panel length, i.e., if $l + l_1 = 0.6\ (l + p)$. The influence line for these moments, as the heel A moves from O toward G, is part of a hyperbola, the axes of which are inclined toward the line OG.

Rapid Construction of Earth-Fill Dam in California

Half Million Yards of Embankment Constructed in Six Months Using Hydraulic Fill Between Dry-Fill Slope Embankments

By Charles H. Richards
Associate, Engineering Office, J. B. Lippincott, Los Angeles, Calif.

HENSHAW Dam on the San Luis Rey River, San Diego County, California, was designed and built in eight months and is now impounding water. It is believed that this time establishes a record when the size of the dam and its remoteness from facilities are considered. The nearest railroad point is 40 miles distant and the nearest supply point, San Diego, is 65 miles away. The dam is also at an elevation of 2,700 ft. above sea level and the roads leading to it are generally mountain grades.

The dam was built for the San Diego County Water Co. to impound water for domestic and irrigation supply, the latter being the larger demand. Power will also be developed at various points along the course of delivery. It will impound the runoff from 210 square miles of mountain watershed, with elevations of 2,600 to 5,000 ft. above sea level, and will create a reservoir of 203,000 acre-feet capacity, which will afford a net safe yield of 28,000 acre-feet annually. A characteristic of the San Luis Rey River is its periodic high flood discharge which has been measured as 28,000 cu.ft. per second. It was the possibility of having such a flood condition that necessitated the building of the dam between two rainy seasons.

In the locality of the dam the rock is more or less fractured and did not assure stable foundations for a concrete structure, but core drill exploration of two sites indicated that an earth-fill dam was adaptable. Again a large spillway is necessary to pass the waste flood waters and since the material in the wasteway was suitable for the outer portions of an earth dam, with a hydraulic-fill center, this type was decided upon. The excavation from the spillway was decomposed granite, with relatively small quantities of fines, and therefore it would have been difficult to construct an impervious dam using this material alone. In order to store the coming winter's runoff it was necessary that all possible speed be made in raising the dam. The site was so narrow that it would have been impossible to complete the dam within the required time by the dry-fill process alone, due to team congestion.

As shown by Fig. 1 the main dam is 117 ft. high from the river bed and the core trench was excavated to a depth of 33 ft. below the stream, giving a total height of 150 ft. Owing to the fractured nature of portions of the cutoff trench, holes 2 in. in diameter and about 20 ft. deep were drilled in the bottom. There were two lines of holes, 6 ft. apart and on 6-ft. centers, staggered. Grout under 100 lb. pressure was forced into the rock through these holes.

The slopes on the two faces of the dam are symmetrical, 2½ on 1 for the first 50 ft. and 2¼ on 1 for the remaining height. These slopes required a bottom width of 600 ft. and the top width was fixed at 20 ft. The main dam is 650 ft. long and contains 400,000 cu.yd. exclusive of the bottom trench. There were 10,000 cu.yd. in this trench, excavated and placed in the outer toes of the fill. A core trench varying from 13 ft. to 5 ft. in depth and from 8 to 5 ft. in width was carried up the slopes of the abutments connecting at its lower end with the bottom trench. All loose and trashy material was stripped from the abutments.

Two smaller dams adjacent to the main dam, Fig. 1, containing about 50,000 cu.yd. were also constructed during the period of building the main dam. These dams are dry earth fills, sprinkled and tamped with petrolithic rollers.

As indicated by Fig. 1, the upstream faces of all the dams are paved with 4 in. of 1:3:6 concrete, reinforced by 6 x 6-in. wire mesh of welded steel. The concrete was poured in 15-ft. panels, alternate joints being made expansive. The lower 45 ft. of the main dam is riprapped with large boulders to a depth of 3 ft. These boulders were wasted from the dry fill as they delayed the progress of the wagons delivering material. Also the downstream toe of the main dam has a riprap apron 10 ft. deep extending 20 ft. in elevation above the toe. In addition to this apron there is a mattress of large boulders covering the original stream bed to a depth of 10 ft. and extending down stream from the toe 100 ft. for the full width of the canyon. This mattress was placed to protect the toe from the back wash of the spillway discharge. The rocks used average about 20 cu.ft. and were placed by a stiff-leg derrick with a 75-ft. boom.

Accessory Structures—The spillway is practically a continuation of the main dam. It is 10 ft. lower than the dam and has a crest length of 500 ft. After leaving the lip the water will flow down a 1 on 1 slope varying from 5 to 15 ft. deep vertically, into a channel paralleling the lip. This channel is 35 ft. wide at its upper end and 180 ft. at the lower end. From it the water will drop to the stream bed on a 1¾ on 1 slope, discharging into the stream after passing over a hydraulic jump designed to reduce the cutting velocity. The wasteway is lined with concrete 6 to 9 in. thick, reinforced with ¾-in. corrugated bars on 12-in. centers in both directions. The steel is placed near the top for expansion and contraction stresses. Expansion joints filled with asphaltum are spaced 30 ft. both ways. Cutoff walls of plain concrete are spaced about 100 ft. apart and extend into the rock 2 ft. below the bottom of the concrete. At the point where the stream leaves the concreted section a cutoff wall 5 ft. thick and 15 ft. deep has been constructed. All concrete is 1:3:6.

When the dam was begun it was thought that possibly sufficient height could not be attained before the early rains set in. To provide for this contingency a flood culvert, as shown by Fig. 1, of horseshoe shape, was designed. Crushed rock was not available at that time so a concrete of 1 cement to 2½ sand, heavily reinforced, was used. Gates are not provided, but two recesses, one at the upstream entrance and one at the center of the dam, were left for plugging when the dam was high enough to store possible floods. From these plug recesses 6-in. pipes were carried through the dam to the top to be used later in pouring the concrete in the plugs. The pipe to the central plug was embedded in 3 ft. of concrete which was the thickness of the culvert shell at this point. Notwithstanding this support, the weight of the pipe and the settling of the clay hydraulic fill pulled the pipe 9 in. down through the concrete. A flange on the pipe above the concrete would probably have prevented this.

An outlet tunnel of the section shown by Fig. 1, was bored through the south abutment, lined with concrete and grouted under 100 lb. pressure. On the axis of the main dam a two-compartment shaft 100 ft. deep connects with the tunnel. At the bottom of the compartment nearest the reservoir an emergency wooden gate and a cast-iron gate, both 4 ft. square, are installed. A 36-in. gate connects the two compartments 35 ft. from the bottom. A similar gate 70 ft. from the bottom has also been installed. The four gates are operated from a gate house on top of the dam.

Construction Equipment—Four steam shovels with ¾-cu.yd. buckets were used in the excavation, each working two nine-hour shifts for six days a week. The material in the dry fill was hauled from the shovels in 1½-cu.yd. dump wagons drawn by two mules. When the grade became too steep, snatch teams, tractors and electric hoists were utilized to assist the single team. When tractors were used, two wagons were coupled into a train. A maximum of 2,800 cu.yd. was obtained in one day of two shifts, or an average of 466 cu.yd. per shovel per nine-hour shift for each of the three shovels. The maximum for one shovel for one nine-hour shift was 809 cu.yd. A large fresno, with shovel teeth, was built to pull the material from the 1¾ on 1 slopes in the spillway to a point where the shovels could pick it up. This was operated by a 50-hp. double-drum motor, having a ⅝-in. tail rope leading to blocks on a cable strung across the top of the steep slope, while a ¾-in. cable was used to drag the scraper with its load.

The hydraulicking equipment was in duplicate, each unit consisting of one 10-in. two-stage, centrifugal pump and two 12 x 30-in. single-stage centrifugal rock pumps. The 10-in. pump delivered 7 sec.-ft. at 140 lb. pressure at the nozzle, which was 1,000 ft. away at its maximum distance, and was driven by a 400-hp. motor.

The pipe used was 10 in. in diameter, of flanged, riveted steel. This pipe carried the water to 3-in. giant nozzles, used to break and wash down the clay banks. From these faces the material flowed through ground sluice ditches on a 3 per cent grade to the 12-in. rock pumps. These pumps required 10 sec.-ft. of water, therefore an auxiliary supply of 3 sec.-ft. was delivered to them. The average of solids transported was 9.6 per cent. From these pumps the material was transported to the dam 2,000 ft. away, through 12-in. diameter welded slip-joint pipe, the steel composing it being known as hard red metal. Two hundred horsepower variable-speed motors were direct-connected to the rock pumps. The pumps were lined with white iron, the liners lasting for about 50,000 cu.yd. before renewal was required. Power under 22,000 v. was brought in through a line 18 miles long. A synchronous condenser of 350 amp. was installed at the dam to improve the load factor, etc.

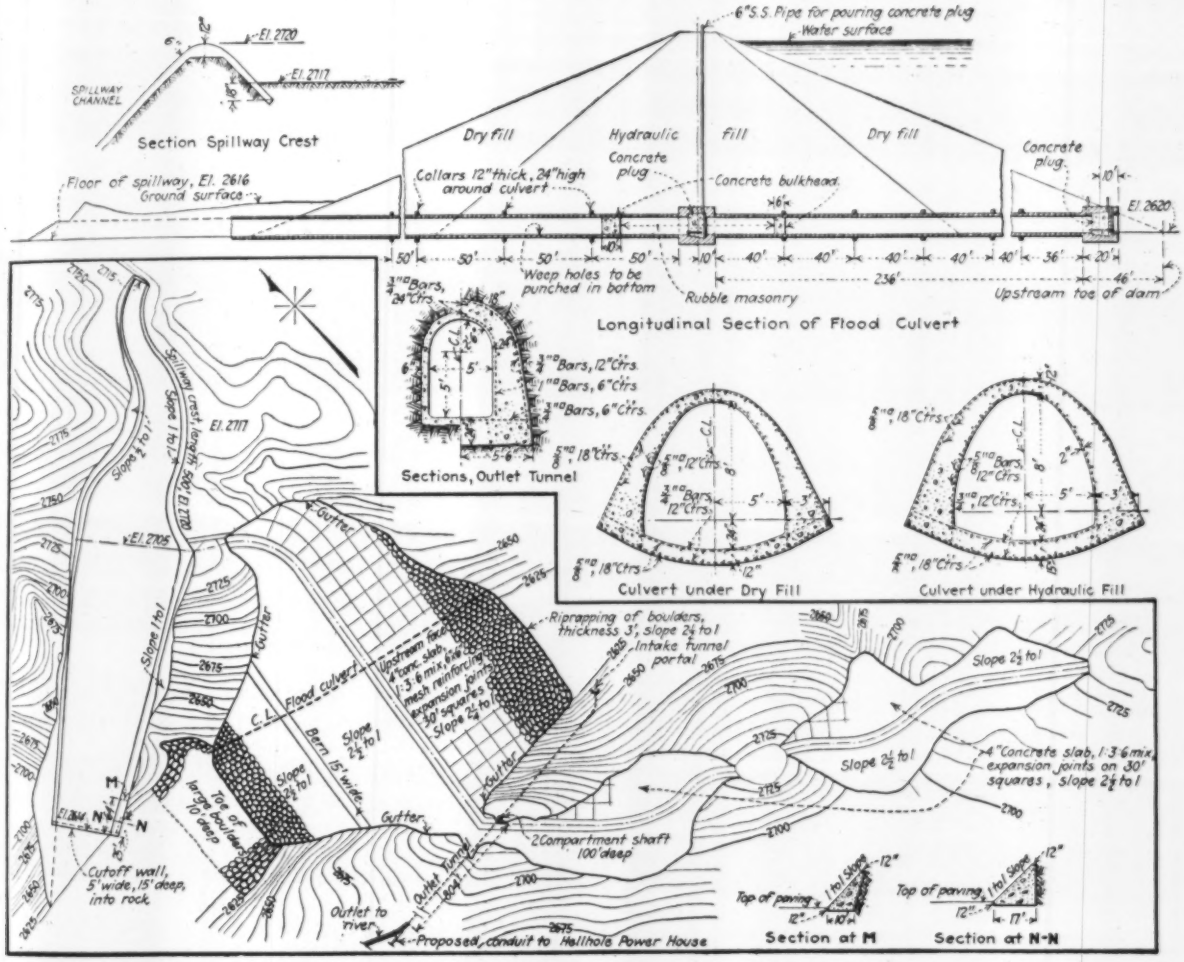

Section Spillway Crest
Longitudinal Section of Flood Culvert
Sections, Outlet Tunnel
Culvert under Dry Fill
Culvert under Hydraulic Fill
Section at M
Section at N-N
Dry fill
Hydraulic fill
Concrete plug
Concrete bulkhead
Collars 12" thick, 24" high around culvert
Weep holes to be punched in bottom
Rubble masonry
Upstream toe of dam
Floor of spillway, El. 2616
Ground surface
Spillway crest
Spillway channel
Flood culvert
Outlet tunnel
Outlet to river
Cutoff wall, 5' wide, 15' deep, into rock
Toe of riprap boulders, 10' deep
Berm 15' wide
Gutter
Riprapping of boulders, thickness 3', slope 2½ to 1
Intake tunnel portal
2-compartment shaft 100' deep
4" Concrete slab, 1:3:6 mix, expansion joints on 30' squares, slope 2½ to 1
Proposed conduit to Hellhole Power House
Top of paving

FIG. 1—PLAN, SECTION AND STRUCTURES OF THE HENSHAW DAM

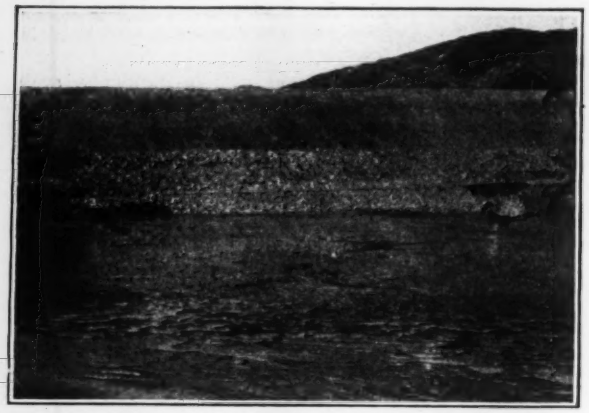


FIG. 2—UPSTREAM SEAL OF FINE CLAY DISCARDED FROM HYDRAULIC FILL

To insure a continuous supply of power, a standby electric plant was installed at the dam. This consisted of two 200-hp. semi-Diesel engines, each direct-connected to a 176-kw. alternator.

Portable compressors were used for furnishing air to the drills. Small drills and a large churn drill boring 6-in. holes were used in the excavation of the spillway.

This analysis shows a relatively large fine clay content. With the fast schedule of construction it was deemed desirable to waste some of these fines as several notable examples of failure of hydraulic-fill dams indicated the danger of rapidly building a dam of this type with a large per cent of very fine material. The fines were allowed to flow off with the excess of water and were deposited above the upper toe of the dam, making an effective seal on the sand at this point. This condition is shown in Fig. 2.

A mechanical analysis of a sample of the clay core material after deposition was as follows:

2-1 mm. (F. G.)	1.560
1-.5 mm.	1.560
.5-.25 mm.	1.600
.25-.10 mm.	18.040
.10-.05 mm.	58.662
.05-.005 mm.	12.948
.005 mm.	5.846
	100.216

The sandy portions of the fill had 26.4 per cent voids and weighed 111 lb. per cubic foot in place, while the clay portion weighed 120 lb. per cubic foot when dried to the consistency of putty.

When the dry-fill toes had reached the point where they were too narrow to work teams, dry-fill material

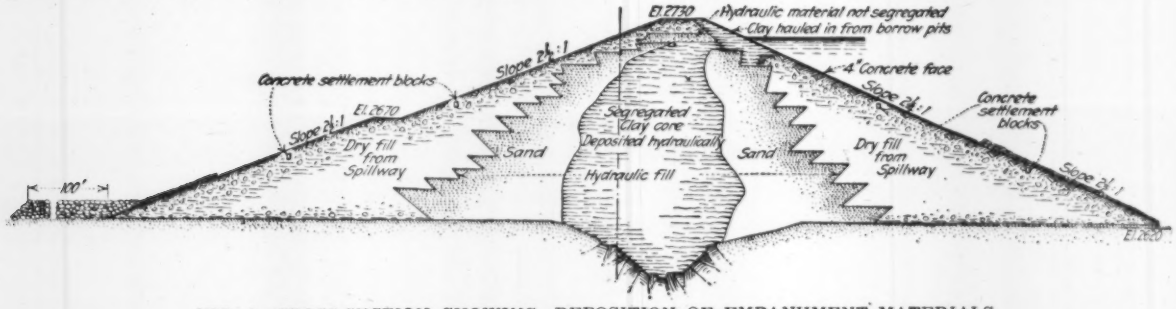


FIG. 3—CROSS-SECTION SHOWING DEPOSITION OF EMBANKMENT MATERIALS

Method of Placing Fills—The dry fill was placed by wagons, spread with small mormon scrapers, and kept wet by sprinkling. Tamping was accomplished by the continual stream of wagons and mules; 1 cu.yd. of loose material compacted to 0.8 cu.yd. in the dam and weighed 3,510 lb. per cubic yard in place. A large percentage of rock was incorporated in the dry fill, particularly on the down-stream toe. An excess of rock made the going too severe for the wagons; when this condition arose the larger rocks were placed on the faces of the dam to form riprap protection. There has been 13 in. of rain on the slopes unprotected by riprap and due to the rocky nature of the face, washing has not taken place. The dry fill was carried approximately 10 ft. above the water level of the summit pool used in the separation of materials in the hydraulic fill.

The hydraulic fill material in the borrow pits was approximately 66 per cent sand and gravel and 33 per cent clay, and analyzed as follows:

Per cent passing 200 mesh	22.30
Per cent passing 100 mesh	38.50
Per cent passing 80 mesh	52.50
Per cent passing 50 mesh	66.00
Per cent passing 40 mesh	72.80
Per cent passing 30 mesh	80.00
Per cent passing 20 mesh	89.60
Per cent passing 10 mesh	98.45
Material washed out, per cent	34.25
Per cent material passing after washing	20.75
Total fines washed out and passing 100 mesh, per cent	55.00

Abrams test for humus indicated a small quantity of organic matter.

was dumped upon the sand beaches of the hydraulic fill. These could then be driven on in two or three hours after placing. This method gave an inverted saw-tooth profile, Fig. 3, to the line between the sand beaches and the dry fill. The progress of the various units of the work governed this line to a large degree. A delay to either of the fills usually meant an encroachment beyond the theoretical line between the fills. These theoretical lines were established by survey and were followed generally, being deviated from only when necessary to avoid stoppage of work.

The hydraulic-fill material was brought through pipes and deposited in about 5 ft. of water, Figs. 4 and 5. A maximum of 3,000 cu.yd. in 24 hours was sluiced out of the borrow pits and when placed in the dam increased in volume by 16 per cent due to the separation of the clay from the voids in the sands. An average of 65,000 cu.yd. per month was obtained, while putting in the bottom portion of the dam. A 16-in. overflow pipe made up of double well casing in 24-in. lengths carried the surplus water back to the reservoir where it was again used for transporting clay to the dam. A collapse of an angle in this pipe was the only defect in the hydraulic equipment.

Test Results—Continuous tests were made of the consolidation if the clay core, using a 6-in. cast-iron ball as the measure of penetration with the following results:

Date	Elevation of Water Surface	Depth to Clay	Penetration in Clay
Sept. 15	2632	4.0	5.2
Oct. 1	2645	3.0	5.4
Oct. 8	2663	5.0	6.2
Oct. 15	2675	7.0	5.1
Oct. 17	2675	5.0	2.7(1)
Oct. 19	2682	9.0	3.0(2)
Oct. 23	2688	4.0	3.0(3)
Oct. 30	2692	3.0	3.5(4)
Nov. 10	2702	6.4	3.3(1)
Nov. 17	2713	3.0	2.0(1)

(1)Average of three; (2)Average of five; (3)Average of two; (4)Average of four.

In addition to these tests, holes were drilled through the culvert into the clay and fitted with 2-in. pipes with valves. Pressure gages were connected at various times and the pressures recorded. On Oct. 19 when the static head on the clay and gravels was 50 ft., the water pressure recorded in the gravels was 8 lb. per square inch and the pressure in the clay was 5 lb. per square inch. When this pressure obtained, the 2-in. pipe would exude the clay material at the rate of 0.13 cu.ft. in one hour. With the clay in this condition a 1¼-in. pipe could be worked into it by one man for a distance of 7 ft. On January 31, 1923, no pressure showed in the clay. No exudation took place in twelve hours and a ⅞-in. bar sharpened at one end could be pushed into the clay for a distance of 5½ ft. showing a very high degree of consolidation.

Tests were made to determine the settlement of the dam. Blocks of concrete were set on each face (Fig. 1) at points one-third and two-thirds of the vertical height above the river bed. Two per cent was added to allow for shrinkage. The following table indicates both the vertical and horizontal movements of the mass.

Upstream Blocks, One-third Way Up; Average of Two.

Date	Vertical Movement	Horizontal Movement
Sept. 13, 1922	0.0′	0.0′
Jan. 2, 1923	0.16′	0.175′ up stream

Upstream Blocks, Two-third Way Up; Average of Two.

Date	Vertical Movement	Horizontal Movement
Oct. 26, 1922	0.0′	0.0′
Jan. 27, 1923	0.39′	0.025′ down stream

Downstream Blocks, One-third Way Up; Average of Two.

Date	Vertical Movement	Horizontal Movement
Sept. 13, 1922	0.0′	0.0′
Jan. 27, 1923	0.29′	0.09′ down stream

Downstream Blocks, Two-third Way Up.

Date	Vertical Movement	Horizontal Movement
Oct. 26, 1922	0.0′	0.0′
Jan. 27, 1923	0.47′	0.04′ up stream

Top of Dam.

Date	Vertical Movement	Horizontal Movement
Jan. 1, 1923	0.0′	——
Jan. 27, 1923	0.15′	——

The dam and reservoir are the fulfilment of the dreams of many people and the project has been under consideration for some thirty years. The realization has been possible only through the foresight and financial courage of Wm. G. Henshaw of San Francisco, Calif., President of the San Diego County Water Co., and John Treanor of Los Angeles, manager of Mr. Henshaw's business affairs in Southern California.

FIG. 4—BEACHES AND POOL OF HYDRAULIC FILL NEAR TOP OF DAM

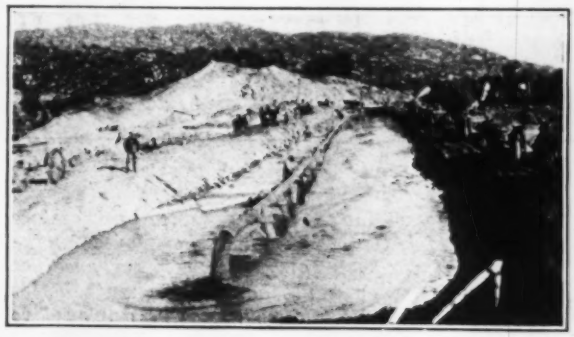


FIG. 5—PLACING LAST LIFT OF CLAY CORE

Henshaw Dam was built on a cost-plus-a-fixed-fee contract, with bonus and penalty clauses. Bent Brothers of Los Angeles, Calif., were the contractors, their superintendent M. H. Slocum being in charge. The late R. C. Starr, of Thebo, Starr & Anderton, San Francisco, Calif., acted as consulting engineer. J. B. Lippincott, of Los Angeles, is the chief engineer for the San Diego County Water Co. and the writer was construction engineer in charge of the work at the dam.

Cut Building Cost and Increase Floor Space by Study of Plans

A REDUCTION of $250,000 in cost and an increase of income in the Straus office building now under construction in Chicago, has been effected by submitting the plans to the National Association of Building Owners and Managers for criticism and suggestions as to interior arrangement and equipment.

According to a statement by the owners, the lateral corridor space between the two banks of elevators from the first to the 13th floors, where express cars will not stop, is to be utilized for extra office space. From the 16th to the 21st floors the elevator corridor space in front of the local elevators will be used for office space not previously planned. This arrangement, together with the gain made by making the walls of the interior court perpendicular instead of terraced, is said to give additional rental area equivalent to adding about $24,000 to the annual income from the building. Further, the elimination of a set-back in the central court at a cost of $50,000 gave additional rentable space equivalent to $25,000 annually.

Chair rails on office walls were eliminated, as it was considered that they do not protect the walls, and with thousands of feet of rail at 35c. per foot the saving was appreciable. Other savings were effected by eliminating sidewalk lights, locks on inside office doors, exterior windows in elevator banks, and one stack of toilets throughout the building.

The Straus building, now under construction, will be 32 stories high and its estimated cost is $15,000,000. Graham, Anderson, Probst & White are the architects for S. W. Straus & Co.

State Engineering In the Highway Bridge Field

Being a Discussion of How Seriously the Field of Private Practice Is Affected By State Highway Bridge Design, By Searcy B. Slack, Atlanta, Ga., and M. W. Torkelson, Madison, Wis.

Charges made against state highway departments by bridge companies and engineers in private practice assert that bridges designed by the state are wasteful, that the engineers employed by the state are incompetent and lack experience, and that the public money would be spent to much better advantage if private engineers were employed to design the bridges. In contrast to present methods, the virtues of the old-time bridge-builder and the methods of a quarter-century ago were extolled by a correspondent in Engineering News-Record *of Sept. 28 last, p. 533. The editors have been urged by other correspondents to denounce the paternalistic system of state bridge engineering and advocate a return to freely competitive practice in the interests of the public as well as of consulting and contracting engineers. A committee of the American Association of Engineers has just taken up the study of how seriously state highway bridge design injures the field of private engineers. In Maine a public statement by the governor recently declared that less costly bridge construction would be adopted; a complete reply to this statement was given by L. N. Edwards, the state's bridge engineer, in the issue of April 19, p. 720. In order to develop the facts of the whole situation,* Engineering News-Record *asked a number of state highway engineers for facts and views. Below are given two of the replies to this inquiry. Without a single reference to the notorious "bridge letting" conditions of an earlier generation they nevertheless picture very clearly certain evils of former practices, now largely eliminated by the effect of state control. At the same time the two articles suggest certain professional problems of the present day.*
—EDITOR.

Former and Present Problems in the Southeast

BY SEARCY B. SLACK
Bridge Engineer, Georgia Highway Department, Atlanta

UNTIL the comparatively recent organization of the state highway departments, except on the large projects and work in a few progressive counties, highway bridge engineering in the Southeast was conspicuous by its absence. The road and bridge work was handled entirely by the county officials, who were generally inexperienced, and exploitation of the field by unscrupulous salesmen and so-called bridge men was the natural result. Honest companies found it difficult to sell good bridges in the face of such competition, and practically all companies were forced to furnish "free engineering." As a result the people, as well as the county officials, did not know what constituted good bridge work and there was little demand for highway bridge engineers.

Realizing the serious side of this situation, in 1912 the engineering department of the University of Georgia organized a good-roads department. The primary object of this department was to help the counties with the road and bridge work and incidentally, by education, to create a demand for highway and bridge engineering. A similar movement was later started in several of the neighboring states. Funds available for this educational work were limited, however, and while good work was being done, it was making slow progress.

With the passage of the Federal Aid road act in 1916, requiring the organization of a state highway department before a state could participate in federal aid, highway engineering took a new lease on life. Highway departments were organized, and work on a better basis was started on the highways and highway bridges. Since this time the education of the county officials and the public in highway and bridge work has advanced rapidly, and there is now some demand for highway bridge engineering. Naturally the counties are turning to the agencies most responsible for the advance of their education and are calling upon the state highway departments for services which possibly could be more properly rendered by county engineers or practicing engineers. Before the organized highway movement, however, both highway and bridge engineers had, in a large measure, failed in selling their services.

Now that the "good roads" movement has gained great headway and there is some demand for highway bridge engineering, it is a proper time for a discussion within the profession concerning the extent to which it is wise to centralize highway bridge work in state and federal departments. There is undoubtedly a field for both the state highway bridge engineers and the specialized bridge expert. The extent of the fields will vary widely with individual cases. The state departments must needs handle a wide variety of structures, the great majority of which a practicing engineer could not economically handle. In exceptional cases, however, such as deep foundations, spans of unusual lengths or unusual movable bridges, expert advice and direction is generally needed.

Many thoughtful people are beginning to catch a glimpse in retrospect of the exploitation and abuses which have been going on at the hands of both bridge companies and engineers, and as a result demand some kind of general supervision by a recognized state agency. Matters of concern to the engineering profession are the abuses within the profession which are so largely responsible for shaking public confidence in engineers. These abuses are quite general, but a few specific examples of more glaring cases may be cited.

An engineering firm with an established reputation in another line accepted design work on several highway bridges. The first bridge or two which they designed proved both unsightly and not economical. Subsequently they accepted designs prepared by a bridge company for several other bridges. Later the board by whom they were employed learned that the engineers had accepted a fee for designs which they had not prepared and on which they were really not competent to pass.

In several cases dissatisfaction has been caused by so-called customary clauses in specifications prepared by

engineers. To the lay mind a fee for the "preparation of plans and supervision of construction" includes all necessary engineering after field work and borings. Some engineers accept fees for this work and then write into the specifications clauses requiring the contractors to pay for testing and all engineering help, except usually the resident engineer, and further require the contractor to furnish the resident engineer an office near the job. When some enterprising layman finds this out after contracts are all signed and work has started he is sure that the engineers are not playing fair. The practice may or may not be right, but by the general public it will certainly be regarded as a questionable practice.

Examples of abuses and foolish designing are, unfortunately, not unusual. Bridge engineers occupy positions of public trust, and no effort should be spared to secure proper standing before the public, but until a more concerted and sincere effort is made by engineers themselves to correct abuses and prevent exploitation, only meager results in securing recognition of professional standing may be expected.

There is a strong sentiment throughout the country for organization of government along business lines. Nearly all large, well organized corporations engaged in a business involving engineering have a staff of engineers capable of carrying out practically any work which is undertaken. If special help on any particularly difficult problem is needed, a consulting engineer is called on to assist the regular engineering staff. In this case the consulting engineer is selected and his work is passed upon by men who are qualified to judge such matters. This system has justified itself economically in the business world. Everyone looks forward to the day when government departments will be organized in such a manner that they can be justified economically. It behooves both the state bridge engineers and the consulting bridge engineers to justify themselves from the purely business point of view and to work together in upbuilding the engineering profession.

* * *

State Work in Wisconsin Has Improved Bridges and Engineering

By M. W. Torkelson
Engineer-Secretary, Wisconsin Highway Commission, Madison

OBJECTIONS made by private engineers and bridge contractors to the practice prevailing in many states of having bridges designed by the state highway departments charge two kinds of waste, that resulting from extravagant notions on the part of state designers concerning the kind of bridge needed, and that due to the incompetence of state designers. When incompetence is alleged it is variously charged to the low salaries paid, to the youth of the men concerned, or to their being state employees and therefore lacking in that progressiveness which is produced only by competitively sharpened wits.

Bad Bridge Work of the Past—Back in 1907, when our state highway department, with advisory powers only, began the work of giving engineering assistance to municipalities desiring to build roads and bridges, both road work and bridge work were in a deplorable state, particularly bridge work, which was not only poorly designed and poorly built but oftentimes carried out with a great deal of plain graft; I know whereof I speak. Contractors and engineers in private practice had been in the field a great many years and had not improved conditions. I believe it is not going too far to say that the improvement in ordinary highway bridge design is due entirely to the activities of the state highway departments.

It may be true that some of the men employed in state departments are incompetent. It certainly is true that many of them are young and that they are underpaid, but all of these objections can be met. Remove those who are incompetent and replace them with other men who are competent; raise the salaries of those who are underpaid. The youth of the remainder will correct itself if given time. There is no proof that engineers in private practice are any more competent than those employed by the state, and certainly those are rare who have the experience in this particular line that is possessed by any one of a dozen state bridge engineers.

Private Engineers and Lawyers—Engineers in private practice claim that the state department is depriving them of business which is theirs legitimately. These engineers never occupied the field when it was vacant. The ordinary township official never would pay a cent for engineering service; he was skeptical of its value, and distrustful of any individual who came to him standing to profit through the transaction. If the engineers in private practice can go out now and continue to get the business, it is because the state departments have educated the public up to an appreciation of the value of engineering services.

Certainly engineers are not the only professional men that the state employs. One of the constitutional officers is the Attorney General, who employs a considerable staff of men belonging to the legal profession. It has never been thought advisable for the state to farm out its legal business in an attempt to advance the interests of the legal fraternity.

Co-operative Spirit—The Wisconsin highway commission has never solicited the employment of its services. Where local officers have shown the slightest tendency to employ the services of an outside engineer, the state department has withdrawn as gracefully as possible. It has never entered a city even on invitation of the city officials unless it was plain that a refusal to do the work desired would result in a bridge letting under the old conditions, where there would be no standards of any kind whatever. Whenever any engineer in private practice has made a request for any information in the possession of the commission, the information has been cheerfully and immediately furnished. We believe that the more engineering there is on our public work, the better it will be.

Before the state entered the field there were less than a half dozen engineering firms, most of them struggling for a precarious existence. At the present time there is not a single one of the good-sized cities of the state but supports an engineer in private practice, and the most of them are not only existing, they are prospering. And the state highway department in a number of instances has been able to give them business where otherwise municipalities would have undertaken the work in the most unscientific manner. I have in mind a small city which found it necessary to increase its water supply. One of the highway commission's engineers happened to have a conversation with a member of the board of public works and learned that they were just

about to conclude arrangements with a well driller to go ahead and dig a well, on the chance of striking water. Through the representations of this employee of the highway commission, the city council became convinced of the necessity of making some tests before digging the well, and after making investigations of various engineers finally employed a competent waterworks engineer.

Charges of Waste—I do not believe that our highway department has ever constructed any bridges very much in excess of minimum needs. Where we have spent some money in an attempt to produce a pleasing effect in the appearance of the work, this has invariably had the greatest appreciation. I remember one county where we had a hard time getting started, because of a hard-boiled county committee, but the committee was pleased with the first bridge and built several, each an improvement in appearance over the one before; finally, a survey for another bridge came in from that county with the request that I "spread myself" on that job.

I have no doubt that cheaper bridges could have been built in some cases, but this would be through a resort to the time-honored process of skinning the job. And as a man cannot, by taking thought, add one cubit to his stature, neither can he by any mathematical process replace the strength and durability lost by cutting out materials that are needed for an enduring piece of bridge work.

I do not believe that a state department should attempt to monopolize the field, but where it can perform a service it should not hold back. This is the policy we have tried to live up to in Wisconsin and we believe it is the correct one. I think there is a place for the state highway departments and for the consulting engineers as well, and that each will be better off because of the prosperity of the other.

Ten Years' Progress in Lighthouse Engineering

AT THE International Congress of Navigation held in July in London (see *Engineering News-Record*, Aug. 2, 1923, p. 175) one section was devoted to the subject "Principal Advances Made Recently in Lighting, Beaconing and Signaling of Coasts." Two of the papers, abstracted here, indicate the recent developments in this, one of the oldest of the engineer's arts. The first abstract is from a paper by George R. Putnam, United States Commissioner of Lighthouses, and a delegate to the Congress, and the second is by the General Reporter of the Section, D. W. Hood, engineer-in-chief to the Corporation of Trinity House (the British lighthouse service).

United States Developments (G. R. Putnam)—The most important advance in lighthouse work in the United States is the establishment of radio fog signals. The lighthouse service on May 1, 1921, placed in operation three radio fog signals in the vicinity of New York harbor, and a number of additional stations have been established or are now being prepared. Each station during fog or low visibility automatically sends radio signals on a 1,000-meter wave length, with a distinctive characteristic. Such signals are used by vessels equipped with radio compasses, and reliable results are being obtained.

Bells operated automatically by carbon dioxide gas have been installed on several buoys and at beacons, taking the place of attended aids, at a large saving. The oscillator, a heavy metal diaphragm electrically vibrated, has been tested for use as a submarine fog signal.

The proportion of sirens and diaphones has been increased, and of steam whistles diminished. A number of distantly controlled fog signals have been installed. A gong buoy, provided with four gongs, has been designed to give a signal distinctive from that of the ordinary bell buoy, and is in successful service.

A great advance has been made in lighted buoys, the number having nearly doubled, and the types improved; there are now 638 in service. The most efficient thus far is the type using dissolved acetylene gas. Over 100 outside lighted sea buoys have been established, supplementing the lightships. Tall type iron buoys have been extensively employed in recent years, and can be more easily seen. A small and inexpensive type of buoy built of thin steel plate has been introduced recently to replace wooden spar buoys in channels subject to ice conditions and heavy traffic.

The United States lighthouse service has in commission 117 tenders and lightvessels and steady progress has been made in improving their design. The latest lightvessels are provided with propelling power, usually steam plants burning oil, but Diesel engines are to be installed on several vessels under construction. On new vessels the illuminant is incandescent electric or acetylene and the principal ones of each type are equipped with radio communication. In ten years the number of automatic gas lights has quadrupled, and the number of incandescent oil lights doubled. There has been a large increase of electric lights for subordinate stations and large economies have resulted.

The greatest change in lighthouse construction in recent years has been the more extended use of reinforced concrete, seven lighthouses having been so constructed, one of which is a tower 162 ft. high. This construction has also been used for foundation caissons, for lighthouses and beacons.

The lighthouse service maintains 16,373 aids to navigation, doubtless the largest number under one control. There has been an increase of 28 per cent in ten years, while in Alaska the number has more than doubled.

Summary of Conclusions (D. W. Hood)—As regards the luminary for optical apparatus, authorities are generally agreed that for buoy and beacon lighting, and in many instances for secondary lights, acetylene gas, either in an open flame burner or with an incandescent mantle, is the most popular form of illuminant where electricity is unobtainable. For larger optics an incandescent mantle on a petroleum vapor burner is the most suitable illuminant unless electricity can be readily obtained at reasonable cost, when the incandescent electric filament lamp may advantageously be employed. The need for continued development in the illumination of lighthouses has not in the least diminished, and in no circumstances must it be neglected in the endeavor to develop Hertzian or acoustic fog warnings. The greater its power the more penetrative will be the beam from the lighthouse and the greatest security is afforded to the mariner by providing a signal which he may see and recognize with his eyes.

Little has been said in the reports about the combination of aerial and maritime lights, and your general reporter is of opinion that such a study is worthy of this conference, in order to avoid separate aerial and maritime lighthouses on the coast.

In connection with acoustical fog signals, authorities generally recognize the superiority of the siren or diaphone over other types. Position finding by wireless is destined to be one of the most important navigational aids of the future, whether employed alone or in conjunction with sound to obtain synchronous signals.

Various countries have different direction-finding systems of their own, nevertheless the problem of the most effective type should be investigated not by each country individually, but by common international agreement, and it appears to your general reporter that a system applicable to stations both ashore and afloat which employs a wireless beam whose direction is ascertained by the navigator himself is the primary basis for such investigation and development.

Alumina Cement in France

Use of Quick-Setting High-Strength Cement Is Growing in France—Possibilities of Its Manufacture and Use

By Edwin C. Eckel
Consulting Engineer, Washington, D. C.

THE TERM alumina cement is here used as a convenient designation for the high-alumina fused cements which are now made and sold on a largely increasing scale under the trade names of *ciment fondu, Alciment, ciment electrique*, and others. It has the advantage of avoiding any implication as to the invention or ownership of the new cements; and as yet there is a very excellent reason for such carefulness in discussing property rights.

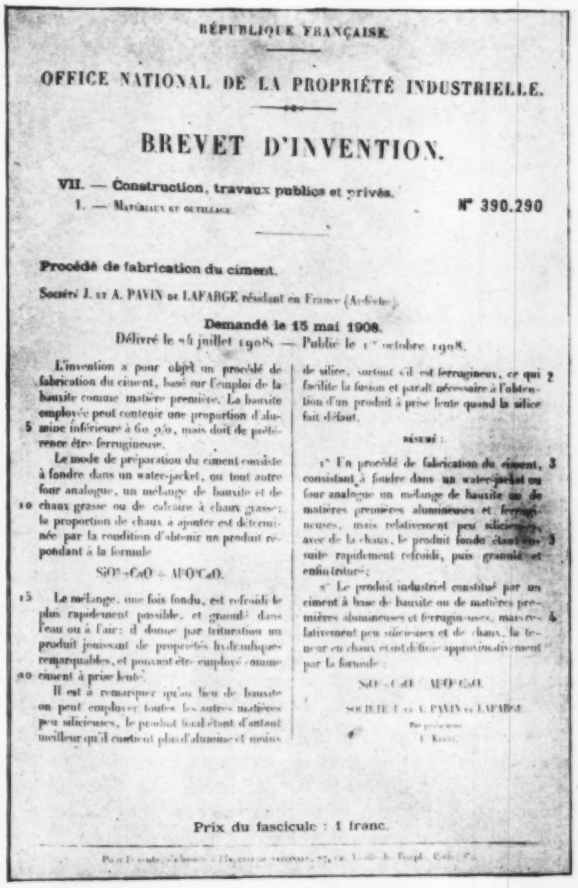
Around 1908 a new type of cement was invented—a cement characteristically very high in alumina, resistant to sea water and to sulphate waters, and hardening with extreme rapidity, so that in a day or two its concrete showed the same results as a normal portland cement concrete after a month or more. In its earliest days its resistance to chemical attack was its chief interest; during the World War it was adopted by the French army for rapid work on gun emplacements and roads; since the war it has been used extensively for ordinary engineering works.

It happened that I was, during the war, in command of a post of which the new fused cements were manufactured and used; and it is probable enough that I was the first American engineer to become acquainted with them. In the summer of 1918 I secured an option on the small available surplus of fused cement, for our own army use; but my immediate superior could not at that time appreciate the advantages of using a quick-hardening product for military uses. Today the situation has changed, and I do not think that any army would dream of using portland cement for front-line work or indeed for any other war-time constructions—provided of course that it had access to a supply of alumina cement.

In the years that have elapsed knowledge of the new product spread gradually, but there was an absolute lack of definite knowledge concerning the actual status of the alumina cement industry in Europe, considered either technically or commercially. There was indeed no lack of publications on the general subject, but these did not, for very good reasons, contain the sort of information which was needed if the developments of the new industry were to be taken up seriously in America. During a recent conference at Le Teil, one of the Lafarge directors noted ironically that the mass of publication was a curious tribute to the public interest in fused-cement, since out of thirty or more articles and papers that had come to his attention, only two were written by men who had ever seen a fused-cement plant, and only three by engineers who had ever used fused-cement in more than laboratory quantities.

Under these circumstances advantage was taken of the fact that examinations of certain European coal and iron fields were desired by one of my British clients, to spend some six weeks of additional time in a study of the status of the alumina cement industry abroad. This was done during May, June and July of 1923, the actual expenses of this part of the trip being paid by a leading American manufacturer of portland cement. The results were rather better than we had expected, in the way of securing detailed data on all phases of the matter. Much of these data, insofar as they relate to ownerships, manufacturing methods and costs, are of course confidential; but certain matters of general interest, relating to the actual growth of the new industry and to the actual utilization of the new product, are summarized in this article

Method of Making—To begin with, we may say briefly that the new alumina cements are made by fusing a mixture of bauxite (aluminum ore) and limestone in a furnace, and grinding the product to powder. That is a brief statement of a complicated series of processes, which have evolved from very different beginnings, and which are yet in process of active development. For example, if we build a mill in America I am very sure that it will be markedly different from any existing French mill; I am almost equally sure that within five years we will make even greater changes and improvements. It is therefore merely as a matter of historic interest that I reproduce herewith, as Fig. 1, a facsimile of the original French patent to Lafarge in 1908.



RÉPUBLIQUE FRANÇAISE.

OFFICE NATIONAL DE LA PROPRIÉTÉ INDUSTRIELLE.

BREVET D'INVENTION.

VII. — Construction, travaux publics et privés.
1. — Matériaux et outillage. N° 390.290

Procédé de fabrication du ciment.

Société J. et A. PAVIN et LAFARGE résidant en France (Ardèche).

Demandé le 15 mai 1908.
Délivré le 24 juillet 1908. — Publié le 1er octobre 1908.

L'invention a pour objet un procédé de fabrication du ciment, basé sur l'emploi de la bauxite comme matière première. La bauxite employée peut contenir une proportion d'alumine inférieure à 60 p/0, mais doit de préférence être ferrugineuse.

Le mode de préparation du ciment consiste à fondre dans un water-jacket, ou tout autre four analogue, un mélange de bauxite et de chaux grasse ou de calcaire à chaux grasse; la proportion de chaux à ajouter est déterminée par la condition d'obtenir un produit répondant à la formule

$$SiO^2 + CaO + Al^2O^3 + Ca^2O.$$

Le mélange, une fois fondu, est refroidi le plus rapidement possible, et granulé dans l'eau ou à l'air; il donne par trituration un produit jouissant de propriétés hydrauliques remarquables, et pouvant être employé comme ciment à prise lente.

Il est à remarquer qu'au lieu de bauxite on peut employer toutes les autres matières peu siliceuses, le produit final étant d'autant meilleur qu'il contient plus d'alumine et moins de silice, surtout s'il est ferrugineux, ce qui facilite la fusion et paraît nécessaire à l'obtention d'un produit à prise lente quand la silice fait défaut.

RÉSUMÉ :

1° Un procédé de fabrication du ciment, consistant à fondre dans un water-jacket ou four analogue un mélange de bauxite ou de matières premières alumineuses et ferrugineuses, mais relativement peu siliceuses, avec de la chaux, le produit fondu étant ensuite rapidement refroidi, puis granulé et enfin trituré;

2° Le produit industriel constitué par un ciment à base de bauxite ou de matières premières alumineuses et ferrugineuses, mais relativement peu siliceuses et de chaux, la teneur en chaux étant définie approximativement par la formule

$$SiO^2 + CaO + Al^2O^3 + Ca^2O.$$

SOCIÉTÉ J. et A. PAVIN et LAFARGE
Par procuration
J. Rivet.

Prix du fascicule : 1 franc.

Pour le texte intégral : Imprimerie nationale, 27, rue Vieille-du-Temple, Paris (4e).

FIG. 1—FACSIMILE OF THE BASIC FRENCH PATENT
Issued in 1908, covering first fused high-alumina cements made at the Lafarge works. This early process has been changed in essential points so that present methods of manufacture are unlike those here claimed.

The claims of the patent, translated, are as follows:

1. Process of cement manufacture, consisting in melting in a water-jacket or similar furnace a mixture of bauxite or of material primarily aluminous and ferruginous, but

FIG. 2—CONCRETE PILING FROM ALUMINA CEMENT
These piles, in Holland, are driven three days after casting.

relatively little silicious, with lime, the fused product being then rapidly hardened, then ground and finally pulverized.

2. The industrial product constituted by a cement with a bauxite base or from material primarily aluminous and ferruginous but relatively little silicious, and lime, the content of lime being defined approximately by the formula $SiO_2 2CaO + Al_2O_3 CaO$.

The reader must consider this patent with the distinct caution in mind that the alumina cement of today can not possibly be made by following the description of that patent. Not only is that the case, but so far as I can see no commercial cement could ever have been successfully made in that fashion. Fifteen years of hard work have changed plant, processes and product so that those of 1908 are no longer recognizable in the modern industry. The result is that the European alumina cement industry of today is rather a matter of more or less secret processes than of patents.

Production—As to the physical growth of the industry, the best data obtainable indicate an output of some 300,000 bbl. ol alumina cement in 1922, of around 350,000 bbl. probable in 1923; and in 1924, with the new mills now reaching completion, a French output of some 400,000 to 450,000 bbl. The significance of these figures can easily be overlooked, if we compare them to American cement outputs; but if we recall that all France does not produce much over six to seven million barrels of true portland cement a year, we see that in four years of actual civil use the new cement has reached an output of about 7 per cent of the total portland output of France.

But though we must admit that the new product can easily reach an important tonnage figure, we must not conclude that it will replace our portland cements for all uses, or that it will ultimately destroy the present cement industry. There are distinct limitations with regard to the commercial placing of the new product, so that its competition with portland—or rather its replacement of portland—will have certain quantity limits which we can fix with sufficient exactness. The carefully weighed opinions of a number of eminent engineers in France, Great Britain and the United States give results ranging between ten per cent and twenty per cent of the portland output as representing the amount of alumina cement that we can reasonably hope to make and sell within the next ten years.

The extent of the competition will be determined solely by cost. Alumina cement will always be, in most parts of the United States, dearer than portland cement, and in many regions it will be very much dearer. That means that it will be to some degree a specialty product, used for such purposes or under such conditions as will justify its extra cost per barrel. Along sea-coasts and in the alkali region of western Canada and our own western states, alumina cements will be used, provided that they are not too dear, because they are resistant to chemical attack. Elsewhere, on repair or construction work where time is an object, alumina cements will be used so far as their higher cost per barrel is counter-balanced by saving on time, labor and forms. For cement products they have very definite advantages, as permitting prompt shipments.

Summary—It may be possible, in a later article, to discuss some of these uses more fully, with illustrations from actual works. But at present perhaps the best commentary on the situation abroad is afforded by the two entirely separate facts which I now note:

(1) In Great Britain, one of the greatest of the contracting companies is about to undertake the manufacture of alumina cement for its own use and for sale, under one of the two processes that are known. As a corollary, perhaps, one of the greatest of British cement manufacturing groups is also about to take up the manufacture of alumina cement, under the other process. In both these cases the necessary bauxite will have

FIG. 3—SUBWAY WORK IN PARIS WITH ALUMINA CEMENT
Photograph taken in 1923. Twenty-four hours after concrete slabs had been laid, back-filling was in progress. The view is at the Chaussée d'Antin station of the Metropolitan subway.

to be imported, so that the incentive to make and use alumina cement must have been very strong.

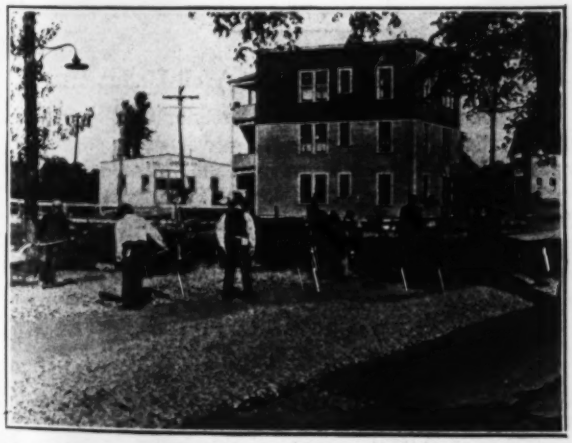
(2) In Paris, though portland cement is still used on alleys and second-class streets, most of the repair work carried on by the city engineers on first-class streets and bridges, as well as that on the subways, is done with alumina cement. By its use a street intersection can be completely repaired with a three-day tie-up of traffic, as against three weeks or so with portland. In Paris today alumina cement costs almost exactly three times as much as good portland. If the slow and economical French mind can see an advantage under such conditions, we may fairly expect that in the course of time Detroit, Chicago and New York may also find it profitable to save time at the expense of first cost.

Asphalt-Penetration Resurfaces Old Macadam Streets

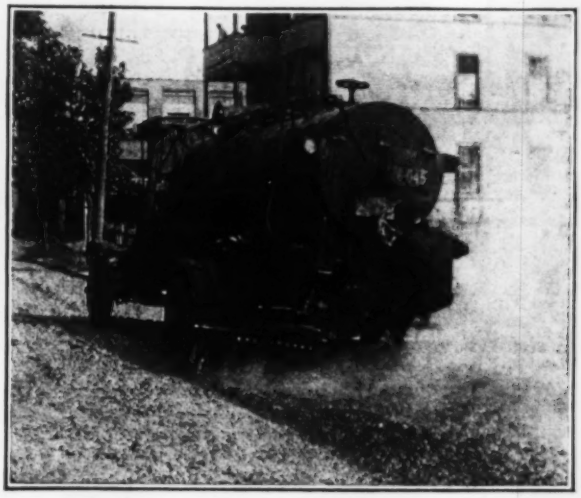
Less than a Dollar a Yard Makes Excellently Surfaced Streets Out of Worn Macadam in Bridgeport, Conn.

OLD WATERBOUND macadam streets, dilapidated by modern traffic, are being converted into excellently surfaced thoroughfares in Bridgeport, Conn., by covering them with asphalt macadam. Not including overhead, the cost in 1922 of 140,000 sq.yd. of 3-in. surfacing was 87.1c. a square yard; and this season, with higher wages and prices, the cost, based on figures for a part of the season, is expected to keep well under a dollar a yard. These low costs are being obtained by a combination of contract and day-labor work which also has given rather excellent progress, the work of 1922 having been done in 140 days—an average of 1,000 sq.yd. a day.

At the beginning of operations in 1922 careful plans were formulated for doing the work by a sequence of crews each performing a particular task. These plans were improved and continued in 1923. This year three crews have done the work for which four were employed in 1922 and also the size of some of the crews has been reduced. It is this reduction of force which has enabled costs in 1923, despite higher wages, and prices, to be kept about as low as in 1922 for which detail figures are given in the accompanying table. In the work tabulated, wages were 35c. an hour and stone per cubic yard delivered cost, for 1½-in., $2.55, and for ¾-in. and ½-in., $2.65. The quantities used were: 1½-in. a 3-in. layer; ¾-in., 20 per cent, of the 1½-in., and ½-in., 0.1 cu.yd. per square yard. Average costs for the 140,000 sq.yd. were as follows:



PLACING NEW WEARING STONE ON OLD MACADAM BASE



SPRAYING ASPHALT ON STONE SURFACING

Grading	$0.072
Extra stone in base	.064
Stone	.290
Asphalt	.330
Surface labor	.087
Coal for surface roller	.004
Heating asphalt in car	.015
Office force	.009
Total	$0.871

In all figures the costs of stone and asphalt are contract prices for these materials in place. The differences in price and quantity of asphalt per square yard are in a considerable measure due to differences in the amount of stone per square yard required to bring the old street to surface. In general the old macadam was badly worn and full of pot holes. Its only usefulness was as a base. Reconstruction consisted of four principal processes, grading, placing stone asphalting and finishing, which in 1922 were conducted as follows:

After the engineers had established the new grades the first crew to enter the street was made up of one foreman, about ten men and a steam roller equipped with a scarifier. The street was scarified and reshaped, some of the surplus material being used to fill in the low places. Where the foundation was poor, new stone was added and the whole street rerolled and left in shape 3 in. below the new grade. The finished crown was ¾ to 1 in. to the foot. With a season's experience it was possible this year to reduce the grading gang by two men. This reduction was aided by the plan of not scarifying the center of the old macadam but was chiefly due to greater skill of the foremen following a year's experience.

The second gang, consisting of one foreman and six men, followed with the stone. The stone, trap rock, was unloaded from a barge by a clamshell bucket directly into a hopper, from which it was loaded into trucks. When a truck arrived on the street the tail gate was chained so that it would open about 6 in. The truck would start as soon as the load was hoisted, and in this way the stone was fairly evenly spread; men with forks corrected any unevennesses. The stone then was rolled by another roller which remained with this crew.

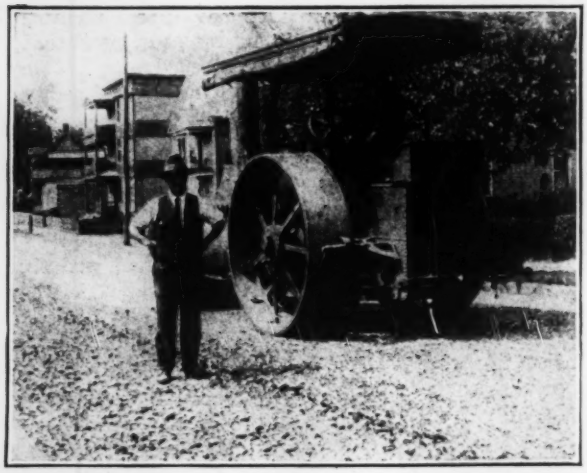
COSTS OF SURFACING WATERBOUND MACADAM WITH BITUMINOUS MACADAM, BRIDGEPORT, CONN.

Street	Area Sq.Yd.	Cost per Square Yard: Grading	Stone Base	Stone Surface	Asphalt	Surface Labor	Heating Asphalt in Car	Coal for Surface Roller	Total	Cost Asphalt per Sq. Yd.
Dewey St.	11,600	.....	.....	.....	.....	.....	.....	.....	$0.95	2.29
Mt. Grove St.									.95	2.29
Hancock Ave.	8,100	.....	.....	.....	.....	.....	.....	.....	.83	2.01
Wordin Ave.	4,925	$0.081	$0.061	$0.300	$0.374	$0.110	$0.025	$0.003	.959	2.49
Hazelwood Ave.	4,200	.085	.050	.284	.332	.096	.025	.002	.879	2.21
Washington Terrace	3,080	.107	.016	.288	.325	.123	.025	.001	.890	2.44
Sanford Pl.	1,983	.064	.....	.298	.296	.100	.025	.003	.784	2.68
Lyon Terrace	1,670	.088	.030	.305	.311	.132	.025	.003	.894	2.49
Chapel St.	1,682	.059	.033	.316	.293	.136	.025	.003	.865	2.77
James St.	3,093	.084	.028	.322	.351	.111	.025	.003	.924	2.35
Fulton St.	1,820	.068	.039	.300	.328	.096	.025	.004	.860	2.82
Franklin St.	1,190	.093	.055	.294	.307	.179	.025	.004	.957	2.70
Frank St.	6,151	.066	.060	.300	.291	.085	.017	.003	.822	2.48
Center St.	5,618	.056	.069	.289	.276	.078	.017	.002	.787	2.71
Charles St.	9,090	.062	.054	.298	.272	.075	.017	.003	.781	2.35
Whitney Ave.	3,758	.065	.095	.310	.379	.066	.017	.003	.935	3.09
Wells St.	4,693	.089	.068	.297	.290	.078	.017	.003	.842	2.69
Park St.	2,724	.072	.062	.323	.304	.082	.017	.003	.863	2.84
Kossuth St.	718	.125	.128	.324	.242	.075	.017	.002	.913	2.25
Brooks St.	6,457	.073	.090	.320	.347	.076	.013	.004	.923	3.22
Jane St.	8,970	.066	.077	.275	.309	.079	.013	.003	.822	2.79
Maple St.	9,262	.072	.066	.294	.298	.093	.013	.004	.860	3.01
Beach St.	4,694	.054	.097	.294	.342	.077	.013	.005	.882	2.77
Ford Place	1,753	.079	.102	.294	.308	.060	.013	.003	.859	3.00
Grant St.	4,267	.077	.077	.294	.292	.074	.013	.003	.830	2.87
Crescent Pl.	857	.059	.092	.285	.323	.085	.013	.003	.860	2.72
California St.	792	.086	.193	.292	.250	.101	.013	.003	.938	3.01
Cedar St.	2,540	.054	.119	.292	.327	.081	.013	.003	.889	2.27
Johnson St.	1,636	.083	.097	.299	.304	.082	.013	.003	.881	2.97
Park Terrace	2,190	.052	.045	.299	.315	.082	.013	.003	.809	2.76
Ellsworth St.	8,637	.095	.119	.294	.321	.108	.013	.005	.955	2.86
Brewster St.	1,245									2.91
Norman St.	5,323	.053	.080	.294	.326	.108	.013	.005	.879	2.97
Housatonic Ave.	1,028	.313	.072	.288	.367	.087	.013	.007	1.147*	3.32
John St.	1,070	.085	.115	.313	.382	.099	.013	.008	1.015	3.47
Middle St.	1,486									
High St.	2,940	.060	.082	.280	.365	.192	.013	.006	.998	3.31
Courtland St.	635	.366	.050	.300	.370	.241	.013	.006	**1.346	3.36

* Grading includes removing 6 in. of old macadam and cinder base. ** Grading includes setting curbs and cutting old road about one foot.

Any low places were brought to grade by one or two men who were placed behind the spreaders. As soon as the stone was ready this gang went ahead to the next street which by this time had been prepared by the grading gang.

The third gang was made up of a foreman and ten men, equipped with a steam roller and one of the new White distributors. Asphalt heated in tank cars at the city yard was applied by this gang at the rate of about 1¾ gal. to the square yard. Three-quarter and half-inch stone had been placed in piles on both sides of the street about 25 ft. apart, the piles on each side alternating. As soon as the asphalt was applied the ¾-in. stone was spread and rolled. When the stone was thoroughly rolled a second application of about ¾ gal. of asphalt was applied and covered with the ½-in. stone. To keep up the speed of the work it was necessary some days, particularly after a wet spell, to apply 6,000 to 8,000 gal. of asphalt a day.



ROLLING AFTER FIRST ASPHALT APPLICATION

In 1922 a forth crew consisting of three men and a team, was employed to touch up places not thoroughly covered, and to clean up the surplus material, but this season this finishing was made a part of the work of gang three.

The following method adopted by the fireman of the boiler used for heating the tank cars helped to assure a continuous supply of asphalt. The exhaust steam from car 1 was piped to car 2 and the exhaust steam from that to car 3. In this way a full head of steam was on the first car and it was ready for use at any time. The second car was almost ready and the third could be made ready in a couple of hours. All shifting of cars was done at night.

Intelligent scheduling of the sequential operations is required but otherwise the procedure involves no special care or unusual methods. In Bridgeport operations are in charge of City Engineer James McElroy and Director of Public Works George Coughlin. City forces do the work except that, as stated, stone and asphalt are contracted for at a price in place.

Humber River Development Well Under Way

Sir Richard Squires, former premier of Newfoundland, in discussing the proposed power development on the Humber River in Newfoundland, states that the project is well under way and that 2,100 men are now employed on work of a preparatory nature which includes the re-location of a considerable portion of the railroad where it traverses the bed of the proposed reservoir. It is hoped that the work will be well under way by the fall of 1924, and that by the following fall the paper plant will be ready for operation. The total development will be somewhere in the neighborhood of 200,000 hp., a considerable portion of which will be used in the manufacture of pulp and paper, as the new plant is expected to produce 400 tons of paper a day.

New Rose Polytechnic Institute Building at Terre Haute

Engineering College on New Country Site Has Main Building of Unusual Design—Laboratories Not in Separate Rooms—Sale of Old City Property Necessitated Rapid Progress

NOVELTY in design, economy in cost and rapidity in both planning and construction are marked features of the main building completed this year for the Rose Polytechnic Institute on its new site just outside Terre Haute, Ind. This triple combination was effected largely in order to meet financial limitations and emergency conditions. The building, Fig. 1, is the first of a proposed group, but for the present it houses all the departments of this engineering college.

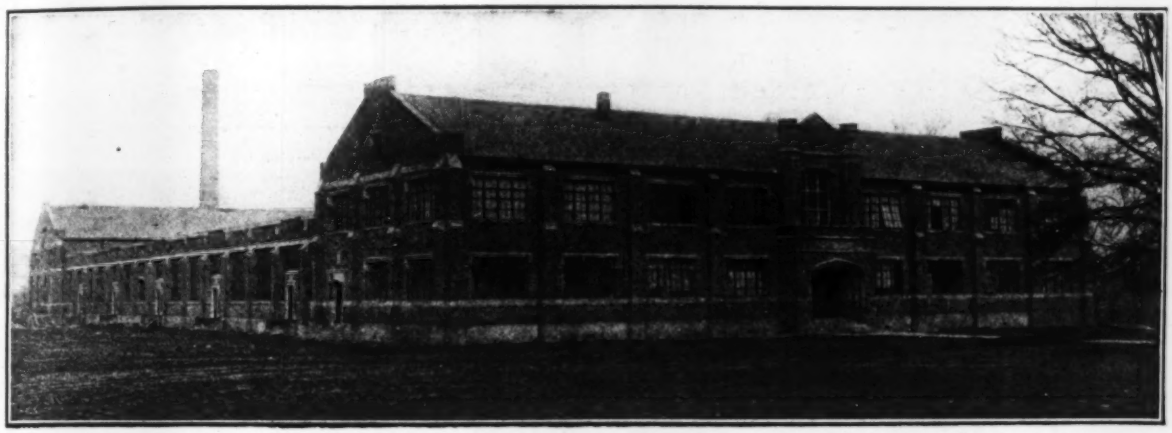


FIG. 1—NEW BUILDING FOR ROSE POLYTECHNIC INSTITUTE

Rose Polytechnic Institute was founded in 1874 by Chauncey Rose, of Terre Haute, Ind., one of the promoters of the Vandalia Line. Until 1922 the institution was located in Terre Haute at 13th and Locust Sts., being housed in a four-story building which was erected in 1876 and had practically no grounds. In recent years the extension of railroad yards in the vicinity has rendered the location unfavorable, while the building was inadequate for the requirements of a modern engineering college and there was no room for expansion. Under these conditions it was decided to remove to a more suitable location in open country which had been provided in 1913 when a site of 120 acres was presented by Anton and Herman Hulman, of Terre Haute, former students of the institution. This site is about 2½ miles from the city, on high ground and fronting on the concrete-paved "National Road," which is paralleled by an electric interurban railway.

A general plan for a group of buildings following somewhat conventional lines for institutions of this kind was prepared in 1916 by Herbert Foltz, architect, and the cost was estimated at about $800,000. A more elaborate plan was desired by the alumni and was worked out in 1918 by John Van Pelt, of New York, but the estimated cost of $1,000,000 for the first building was far beyond the reach of the institution. No further action was taken at the time. But in 1918 the institution had sold its building and property to the city for school purposes and early in 1921 the city demanded possession, since it desired to use the building for a vocational high school. Thus the institution was compelled to move but had no buildings of its own.

At about this time, Dr. Philip B. Woodworth, Dean of Engineering at Lewis Institute, Chicago, was made president of Rose Polytechnic Institute, and the work of providing quarters was his first and most pressing problem. An analysis of the finances showed about $300,000 available. Dr. Woodworth then called in Mr. Foltz, the architect of the original plan, and between them a design was worked out for one main building which could be made to serve all purposes for a few years. It is this building which is now completed.

In its interior arrangement, however, the building presents a new departure in the design of educational buildings. In plan the structure is about 150x400 ft. and with the exception of the two end portions, front and rear, it is one story high. The central portion is divided into sections by transverse partition walls of

FIG. 2—DEPARTMENT OF DRAWING AND MACHINE DESIGN

Northeast corner of room. Civil engineering laboratory beyond first low partition. Well diffused light from large windows and skylights. I-beam at left will carry mezzanine floor for toilets.

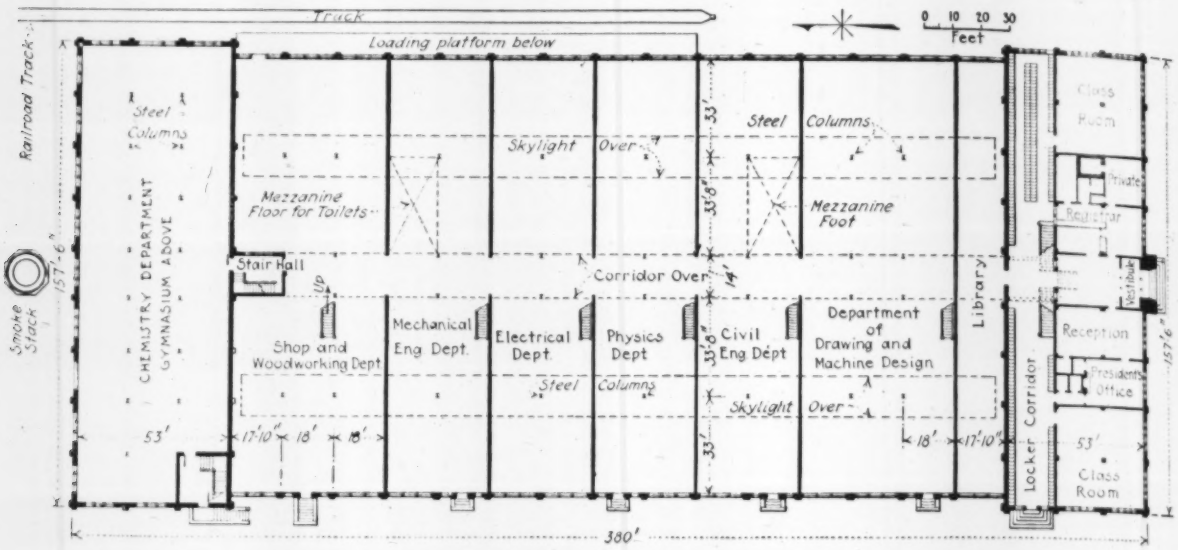


FIG. 3—COMPARTMENT ARRANGEMENT OF LABORATORIES

brick, as shown by Fig. 3 and the accompanying interior views, but these walls are carried only to a height of about 10 ft., so that the upper part of the one-story structure is open from end to end, giving free diffusion of light from the skylights. The first partition at each end, however, is carried somewhat higher, as shown by the drawing Fig. 5 and the view Fig. 6.

It was originally intended that each partition should be continuous between the side walls, forming isolated sections for the laboratories. At present, however, there is a central line of openings permitting direct communication Along the center line of the building and about 9½ ft. above the floor is an open gangway or corridor 14 ft. wide, having iron railings along the sides and an iron stairway to each laboratory. In addition, each laboratory has a door in one side wall. In Fig. 6, the first partition, which extends above the corridor, is that between the library and the drafting room. Beyond it, the partitions between the sections or laboratories are about level with the floor of the corridor. These sections, Fig. 3, comprise the following: Library, drawing and machine design, civil engineering,

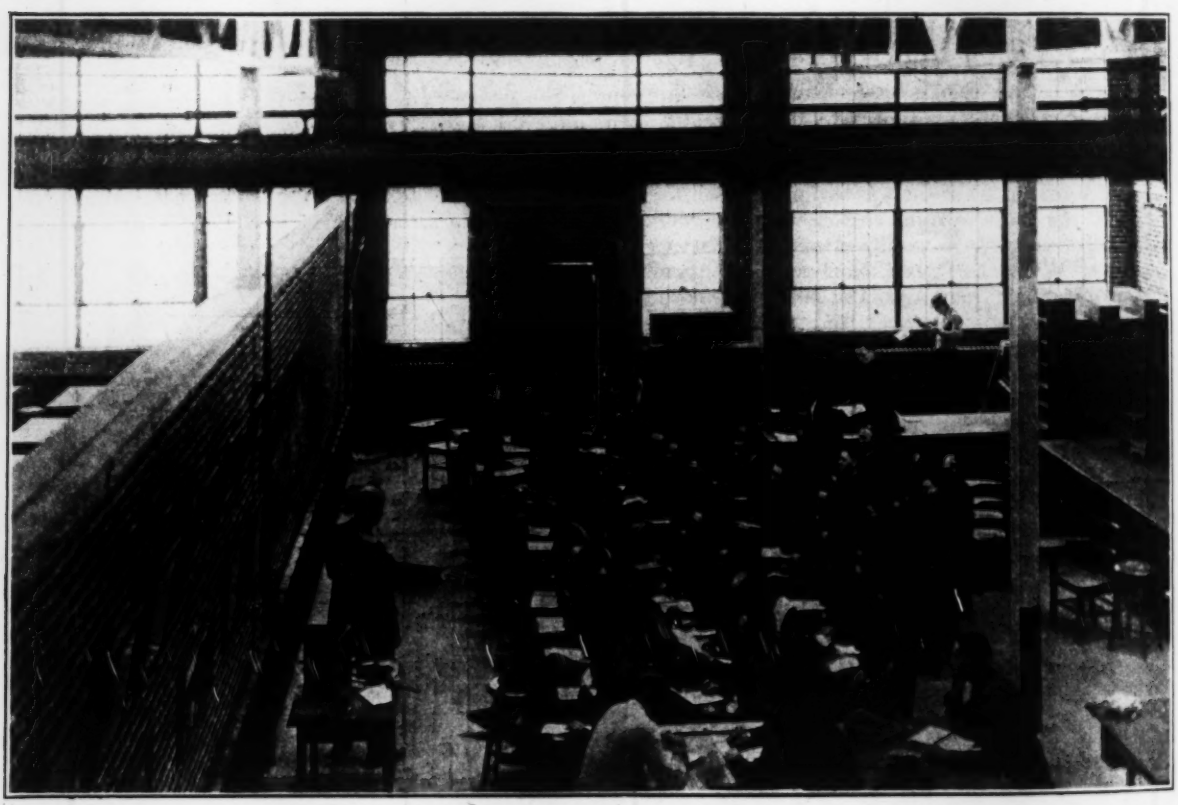


FIG. 4—CIVIL ENGINEERING LABORATORY
Southwest corner of room. Prof. R. L. McCormick teaching class. Note low brick partition separating this room from drafting room at left.

FIG. 6—ELEVATED CORRIDOR CONNECTING LABORATORIES

High partition in foreground separates the library from the drafting department, access to which is by stairs at left. Triangular skylight above. Heavy I-beam beyond first partition wall at right will carry mezzanine floor.

physics, electrical engineering, mechanical engineering, and shop and woodworking department. Of these the drafting and shop department and the chemical engineering laboratory (under the gymnasium) have each 8,000 sq.ft. of floor area; the others have 5,000 sq.ft. each, except the library with 3,000 sq.ft. Under the drafting department is a shooting gallery 36 ft. wide extending the full width of the building.

In the two-story front portion of the building, 54 ft. wide, the administration offices and some of the class rooms are arranged on the first floor and other class rooms are on the second floor, which is about 3 ft. above the level of the longitudinal corridor in the central one-story part of the building. The rear two-story portion, also 54 ft. wide, has the assembly room or gymnasium on the second floor and the chemical laboratory on the main floor. Beneath the latter are the boiler room and the foundry, each occupying half the width of the building. Owing to the downward grade of the ground towards the rear these two rooms do not form a closed basement but the floor is level with the ground at the rear of the building. Toilet rooms are arranged on a mezzanine floor over

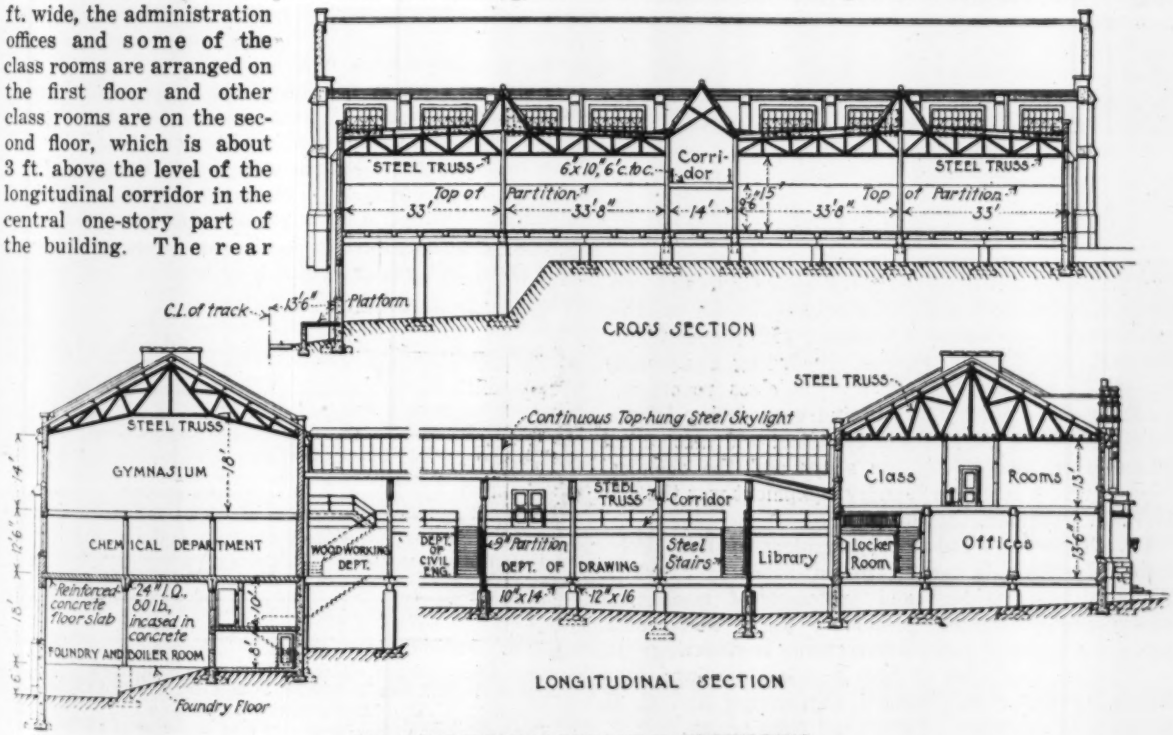


FIG. 5—GENERAL DESIGN OF MAIN BUILDING

a portion of the laboratories and at the level of the corridor. Only one of these floors has been built as yet, but on Figs. 2 and 6 will be noted a heavy I-beam which will support the second mezzanine floor section.

Structural design includes brick walls, steel columns and steel roof framing, with mill construction for the upper floors of the two-story end sections. A reinforced-concrete floor on I-beam framing is provided for the chemical department, but elsewhere there is 2⅝-in. wood mill flooring on joists, generally 10x14-in. and 6 ft. apart, these joists being carried by 12x16-in. girders on concrete foundations. For the corridor the joists are 6x10-in., 6 ft. apart, fitted between the flanges of two lines of 12-in. channels riveted against the interior steel columns. Steel sash forms a large proportion of the side walls, as glazed areas are cheaper than masonry. The partitions and interior facing of the side walls are of dark red face brick and will not be plastered. Transverse steel roof trusses supported on columns in the side walls and on intermediate steel columns in the central one-story part of the building carry three continuous longitudinal skylights of triangular section, with movable panels for ventilation. In this way abundant light is provided, but shades will be needed in sunny weather. The intermediate portions of this roof and also the roofs of the end sections of the building have plank sheathing and composition roofing, which will be covered eventually with red tile. Rough texture brick with white stone trimmings is used for all exterior walls.

Water for drinking purposes is pumped from a driven well to an 80-gal. storage tank. For laboratory and general purposes and for fire protection there is a 200,000-gal. concrete tank or cistern in the basement to collect rain water. This cistern is connected with a small lake 660 ft. distant by a 10-in. cast-iron main, at the middle of which is a sump from which fire engines can draw water. The normal level of the water in the cistern and lake is 13 ft. above that of the boiler room floor. With the power plant located in the building there is a saving in heat loss and fuel cost as compared with an outside power house and pipe tunnel. Two hand-fired water-tube boilers of 160 hp. are installed. Coal is delivered by cars on a railroad spur.

This one building serves all purposes of the institution at present. The next building, as planned, will be Deming Hall, a students' union building, for which $100,000 was provided in the will of Demas Deming, of Terre Haute.

With the exercise of economy in design and construction, the cost was about $240,000 for the building and $320,000 including equipment. In proportioning the cost, the limit of expense (including equipment) was $3.50 per square foot for the class rooms and drafting room, $3.80 for the civil engineering laboratory, $4 for the physics and electrical and mechanical laboratories, and $5 for the shops and the chemical laboratory. A complete foundry equipment was the gift of E. D. Frohman, Pittsburgh, Pa.

Dr. Philip B. Woodworth, president of Rose Polytechnic Institute, is now on leave of absence; Frank C. Wagner, vice-president and professor of mechanical engineering, is acting president; R. L. McCormick, professor of civil and architectural engineering; H. A. Thomas, professor of hydraulic engineering; John White, professor of chemical engineering and C. C. Knipmeyer, professor of electrical engineering.

The Paradox of Hydro-Steam

An Analysis to Show That Energy Generated by Combined Steam and Hydro Prime Movers Can Cost Less Than Either One Separately

BY GEORGE HOLMES MOORE
Senior Electric Engineer, Public Service Commission of Washington, Olympia, Wash.

ONE of the most interesting of the problems encountered in hydro-electric engineering is the computation of the economic size of the steam auxiliary. In fact, certain of the conclusions arrived at by an intensive study of this economic size relation are so unexpected as to seem at first glance preposterous. Thus, when the student has become convinced that hydro-electric energy can be sold with profit at 6 mills per kw., and that steam-electric energy can be so sold at 10 mills per kw., it is extremely difficult for him to conceive that energy, generated by the two methods operating in conjunction, can be profitably sold at 5 mills per kw.

And yet this condition of affairs is by no means impossible of attainment, as a review of such articles as those of Stott, Gorsuch and Baum may suggest. Baum has declared in his paper on the "Economic Proportion of Hydro-Electric and Steam Power" (A. I. E. E., *Trans.* 1918, p. 1471), that: "It is, of course, well known that steam power is usually less expensive for low load factors than hydro-electric power, and that the latter becomes economical only when the load factor is favorable."

Another author in an article directing attention to "The Possibilities of Hydro-Electric Power in the Pacific Northwest" (*Engineering News*, Vol. 73, p. 342), shows that: "The immense preponderance of water-power drive throughout the Pacific States admits of but one conclusion—the local superiority of water over steam. There is little room for doubt as to the economic standing of the two prime movers on the Pacific Coast"; from which it is readily apparent that seemingly contradictory statements may emanate from trained investigators, even in the same locality and in the same field of research.

However, the paradoxical condition can—and doubtless does—exist. Electric energy can, in certain instances, be produced at a lower unit cost by hydro and steam stations operating in parallel than by either when operating alone. And it is the purpose and intent of this paper to present, as simply as may be, those essen-

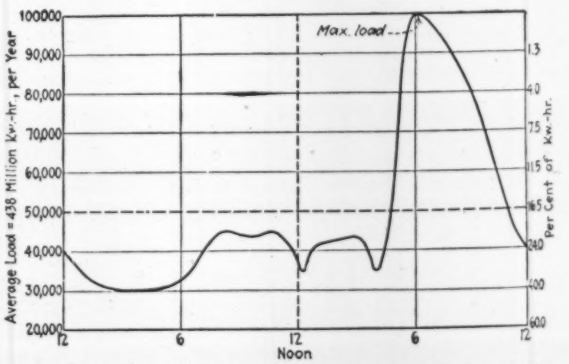


FIG. 1—DAILY LOAD CURVE FOR A REPRESENTATIVE CITY LIGHT PLANT
Composite mean form for yearly load factor of 50 per cent.

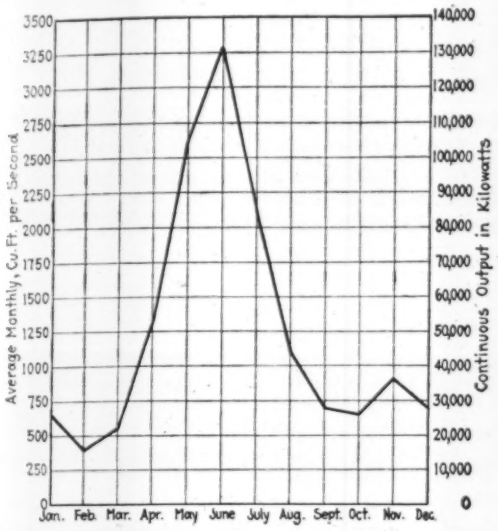


FIG. 2—ANNUAL RECORD OF STREAM FLOW

tial elements of control which, at least for Pacific Northwest conditions, dictate the economic proportionment of hydro-electric and steam-electric generating plant capacities.

Two of the most important of the basic data required for the analysis of a power stream destined to supply any particular distribution system are: 1. Annual System Load Curve and 2, Annual Record of Stream Flow.

System Load Curve—In Fig. 1 is presented a composite mean form of daily load curve as obtained from a certain large system from a record extending over a number of years. This particular annual load curve has a load factor of 50 per cent, so that a 100,000 kw. power station supplying it would have an annual output corresponding to 50,000 kw. continuous; or an annual total of 50,000 × 8,760 = 438 million kw.-hr. per year.

Annual Record of Stream Flow—Of the many surprising elements disclosed by the careful hydrographic study of a power stream, there are three which may be said to control. These are respectively:

(a) Minimum Stream Flow
(b) Storage Requisite for Daily Regulation
(c) Storage Requisite for Annual Regulation.

Of these three, the one first sought and most commonly used as a basis for station capacity estimate is that of Minimum Flow, and just because the commonest hydro-electric installations are those designed to operate at full capacity during the months of Minimum Flow, the paradoxical inter-relation of hydro and steam has not yet received the attention its importance merits.

Daily Regulating Storage—An analytic consideration of Fig. 1 will prove that the station capacity which may wisely be installed upon any given power stream can be exactly doubled if sufficient storage can be secured to provide daily regulation of the stream flow. Daily Regulating Storage may be here defined as that volume necessary to change the normal flow so as to conform to the daily load requirements of the system supplied. The acre-feet of storage required for this purpose is relatively small, but, if the average stream flow will generate 50,000 kw. continuously, such storage will allow of the installation of a 100,000 kw. plant under the load conditions shown in Fig. 1.

Further study of this load curve discloses that the energy necessary for load between 50,000 kw. and 100,000 kw. is only one-sixth of that necessary to generate 50,000 kw. continuously, so that in this case the reservoir volume for daily regulation would be one-sixth the volume of daily stream flow.

Economic Utilization of Stream Flow—Let us assume that the load demanded for the curve of Fig. 1 is supplied by a power station located on a stream whose Annual Record of Flow is that shown in Fig. 2. If the static head of this development is 600 ft., each cubic foot per second of water should produce 40 kw. of continuous output; or, on a daily load factor of 50 per cent, it should produce 80 kw. at time of peak if daily regulating storage is available.

Let us assume that the reservoir volume developed is sufficient for daily regulation of the average annual flow as shown in Fig. 2. The 1,250 sec.-ft. of mean flow will then be just sufficient to drive a 100,000-kw. hydro station with an average output of 50,000 kw. continuously. From the foregoing, the storage necessary in this case is:

$$0.165 \times 1250 \times 60 \times 60 \times 24$$
$$= 17.82 \text{ million cu.ft.}$$
$$= 409.09 \text{ acre-feet.}$$

This reservoir volume would be sufficient to store the Minimum Flow of 400 sec.-ft. for a period of:

$$17{,}820{,}000 \div (400 \times 60 \times 60)$$
$$= 12.375 \text{ hr.}$$

From which it follows that, if the steam auxiliary can supply the demand during 12.375 hours of the lightest load, enough water will accumulate in the reservoir during that period to operate a 50,000 kw. station during the hours of peak load, and thus to supply all demands between 50,000 kw. and 100,000 kw. during that time.

Adding to this 50,000 kw., the 16,000 kw. available from the Minimum Flow of 400 sec.-ft., it becomes evident that only 34,000 kw. of steam auxiliary need be provided in order to supply 50,000 kw. continuous and 100,000 kw. peak even under the limiting condition of Minimum Stream Flow.

Hydro-Steam Cheaper than Hydro or Steam—It now remains only to demonstrate the major proposition advanced herein, namely: that energy produced by the combination of hydro and steam is cheaper than that produced by either hydro or steam when operating alone.

From the foregoing, it is evident that a 32,000 kw. hydro station is the largest that should be installed on the given stream under the conditions as assigned, if no steam auxiliary is provided; and the following tabulation presents an estimate of installation and operating

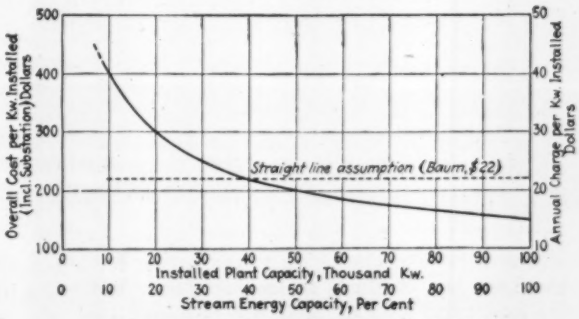

Overall Cost per Kw. Installed (Incl. Substation) Dollars
Annual Charge per Kw. Installed Dollars
Straight line assumption (Baum, $22)
Installed Plant Capacity, Thousand Kw.
Stream Energy Capacity, Per Cent

FIG. 3—INSTALLATION COST OF HYDRO-ELECTRIC PLANTS

Curve showing decrease of unit cost and annual charge with increase of installed capacity.

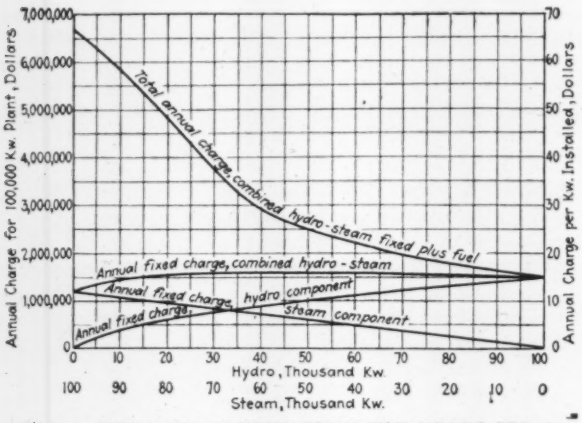

Annual Charge for 100,000 Kw. Plant, Dollars
Annual Charge per Kw. Installed, Dollars
Total annual charge, combined hydro-steam fixed plus fuel
Annual fixed charge, combined hydro-steam
Annual fixed charge, hydro component
Annual fixed charge, steam component
Hydro, Thousand Kw.
Steam, Thousand Kw.

FIG. 4—ECONOMIC COMBINATIONS FOR HYDRO-STEAM ELECTRIC PLANTS

	Hydro	Steam
Cost per Kw.:		
20,000	$300	$100
30,000	250	..
50,000	200	..
100,000	150	100
Fixed Charge:		
Interest	6%	6%
Depreciation, etc.	4%	6%

Fuel charge, oil @ 200 kw.-hr., per $2.50 bbl.
Load factor yearly, 50% installed.
Load curve, typical city light plant.

costs for a 32,000 kw. hydro station supplying a demand whose load factor is 50 per cent. Such a load will require an energy production equivalent to a continuous average of 16,000 kw. throughout the year.

Installation cost of hydro is assumed to vary as shown in Fig. 3, being $400 per kw. installed for a station capacity of 10,000 kw., and decreasing to $150 per kw. for an installation of 100,000 kw.

Installation cost of steam is assumed constant at $100 per kw. installed, regardless of the station capacity.

Base data for the computation of annual operating expense are given in Fig. 4, among which that of oil at $2.50 per bbl. will be revised to $1.40 per bbl. in a later study.

Applying the data of Figs. 3 and 4, the following comparative tabulation results:

Item	Hydro	Steam
Installation cost (32,000 kw.)	$7,744,000	$3,200,000
Annual fixed charge	$774,400	$384,000
Annual fuel charge	.....	1,752,000
Total annual charge	$774,400	$2,136,000
Annual kw.-hr. $\left(\frac{\text{kw.}}{2} \times 8{,}760\right)$	140,160,000	140,160,000
Annual cost per kw.-hr.	$0.0055	$0.0152

Changing only the item of fuel from $2.50 to $1.40 per bbl., and adding another column for a hydro steam plant of the size indicated, we obtain the tabulation given below.

Item	32,000 Kw., Hydro	32,000 Kw., Steam	32,000 + 18,000 Kw., Hydro-Steam
Installation cost	$7,744,000	$3,200,000	$9,344,000
Annual fixed charge	$774,400	$384,000	$966,400
Annual fuel charge	.....	981,120	153,300
Total annual charge	$774,400	$1,365,120	$1,119,700
Annual kw.-hr. $\left(\frac{\text{kw.}}{2} \times 8{,}760\right)$	140,160,000	140,160,000	219,000,000
Annual cost per kw.-hr.	$0.0055	$0.0096	$0.0051

A word of explanation as to the reason for choosing an 18,000 kw. auxiliary is due just here: Referring to the load curve of Fig. 1, it will be found that, if the peak load is taken as 50,000 kw. instead of 100,000 kw., the annual daily average will be 25,000 kw., and this will, in the 8,760 hours of a year, amount to the 219 million kw.-hr. of column 4. Also, closer inspection will reveal that all loads above 64 per cent of the peak, (which 64 per cent is, in this case, 32,000 kw.), will demand only about one-tenth of the annual energy, or 219 million kw.-hr., to be furnished by the steam plant. This energy, at 7 mills per kw.-hr., will produce the fuel charge of $153,300 as given in column 4.

Even this is not the most favorable proportionment that could be obtained, since it entails an annual load factor for the steam plant of nearly 14 per cent, whereas a 10 per cent load factor for the steam auxiliary would probably result in a greater economy of output. This would probably decrease the 18,000 kw. as here chosen, but the resulting decrease in energy cost is unimportant here.

From which it is evident that the paradox—which Webster defines as "something apparently absurd or incredible, yet true"—really does exist. Not only does a carefully chosen proportion of steam to hydro cheapen the unit cost of the energy produced, but also it makes possible the conservation, by use, of enormously increased quantities of power stream energy.

Thus, in the case cited, it will be found by further analysis that 32,000 kw. is only, in a manner of speaking, the beginning of the installed capacity that may economically be installed on the stream as chosen.

The available storage will usually be far greater than that requisite for daily regulation, and probably will be sufficient to materially augment the Minimum Stream

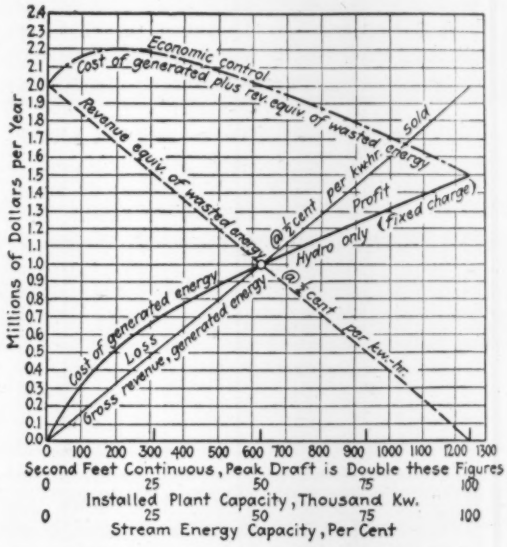

Millions of Dollars per Year
Economic control
Cost of generated plus rev. equiv. of wasted sold
Revenue equiv. of wasted energy @ ¢ cent per kwhr. energy
Profit
Hydro only (Fixed charge)
Cost of generated energy
Loss
Gross revenue, generated energy @ ¢ cent per kw.-hr.
Second Feet Continuous, Peak Draft is Double these Figures
Installed Plant Capacity, Thousand Kw.
Stream Energy Capacity, Per Cent

FIG. 5—ECONOMIC CONTROL CURVES

Showing variations of cost, revenue and waste, as the installed plant capacity varies from 0 to 100 per cent of stream energy capacity. It is assumed that, under a static head of 600 ft., each sec.ft. will produce 40 kw. continuous and 80 kw. peak, under an annual load factor of 50 per cent. Also, that, of the 4,380 kw.-hr. generated per year by each kw. of plant capacity, 4,000 kw.-hr. will be sold.

Flow. So that the installable hydro station capacity will increase from 32,000 kw. toward 100,000 kw., and sometimes above that figure.

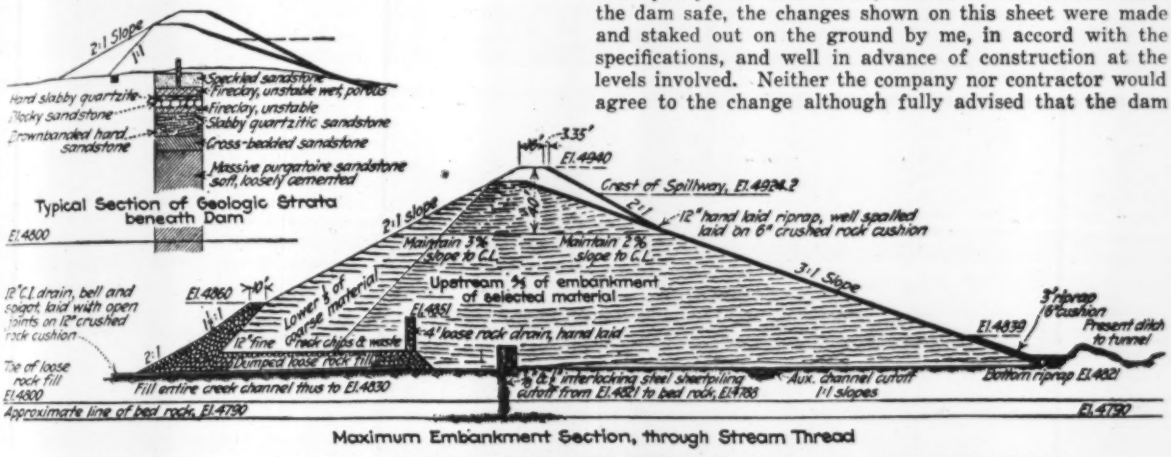
Indeed, if we define the economic control for power stream development as "the cost of generated energy plus the revenue equivalent of wasted stream energy," it will be seen from Fig. 5 that this sum in "millions of dollars per year" is a minimum only when the stream is developed to its ultimate capacity. Which statement may be, itself, a paradox.

Failure of Apishapa Earth Dam in Southern Colorado

Structure 115 Ft. High Above River Bed Goes Out After Stream of Water Breaks Diagonally Through Upper Portion

With Telegraphic Reports from Special Correspondents

THE APISHAPA DAM, near Fowler, Colo., an earth structure 115 ft. from stream bed to dam crest, failed on Aug. 22, with a water level behind the dam variously reported as from 2 to 3 ft. below the spillway and 10 to 13 ft. below the crest, the water being some 10 ft. higher than it had ever been before. Leaks attributed to settlement cracks had been observed a year ago. Just before the failure a crew of men under the chief engineer of the Apishapa Consolidated Irrigation Co., owners of the dam, had, as was thought, practically stopped the leaks. These leaks were at each end of the dam, about 25 ft. below the crest.


2:1 Slope
1:1
Hard slabby quartzite
Blocky sandstone
Brownbanded hard sandstone
Speckled sandstone
Firecley, unstable wet, porous
Firecley, unstable
Slabby quartzitic sandstone
Cross-bedded sandstone
Massive purgatoire sandstone soft, loosely cemented
Typical Section of Geologic Strata beneath Dam
El. 4800
El. 4940
Crest of Spillway, El. 4934.2
12" hand laid riprap, well spalled laid on 6" crushed rock cushion
Maintain 3% slope to C.L.
Maintain 2% slope to C.L.
Upstream 3/4 of embankment of selected material
Lower 1/4 of selected material
3:1 Slope
El. 4860
El. 4851
12" fine rock chips & waste
4' loose rock drain, hand laid
12" C.I. drain, bell and spigot, laid with open joints on 12" crushed rock cushion
Toe of loose rock fill El. 4800
Dumped loose rock fill
Fill entire creek channel thus to El. 4830
Approximate line of bed rock, El. 4790
6" C.I. interlocking steel sheetpiling cutoff from El. 4821 to bed rock, El. 4786
Aux. channel cutoff 1:1 slopes
El. 4839
3' riprap 6' cushion
Present ditch to tunnel
Bottom riprap El. 4821
El. 4790
Maximum Embankment Section, through Stream Thread

MAXIMUM CROSS-SECTION OF APISHAPA DAM IN SOUTHERN COLORADO AS COMPLETED IN 1920.

The dam was 585 ft. long at the crest and 300 ft. at the bottom. The thickness at maximum cross-section was 594 ft.
The crest of the dam as built is at the top level of the cross-lined section (El. 4932). The additional section up to El. 4940 was so designed by the engineer, after certain discrepancies in the preliminary survey were discovered, but was never built.

Warning of failure came when water was seen entering the dam at the water surface at one end, to be followed soon afterward by a discharge at the other end, some 25 ft. lower down or about 35 ft. below the crest. The water level fell slowly for an hour, then more and more rapidly until within three hours the reservoir had lost 18,000 acre-ft. of storage. Meanwhile the dam, except for portions at either end (and perhaps some of what was under water), had gone downstream with the flood.

The dam, which was described at length in *Engineering News-Record*, June 16, 1921, p. 1030, by Clair V. Mann, engineer in charge of construction, and also of re-design, was completed in September, 1920. It was designed to guard against underflow along either the earth on which it rested or along the rock below, and drains had been provided in the rock fill beneath the downstream third of the dam. The original plan, Mr. Mann stated in his article, was to build "a concrete cutoff wall extending down to bed rock, and up from stream bed a height of 50 ft.," but as this was not "within the company's means," the cutoff just described was substituted. Mr. Mann also states in his article that as originally planned the dam was to have been carried 120 ft. above the stream bedrock but that "financial considerations" restricted the height to 115 ft., thus leaving the crest of the dam "only 7.8 ft. above the spillway crest, and the writer [Mr. Mann] considers this insufficient margin for safety."

Mr. Mann is on record even more specifically than this as to this danger. In a protest and warning printed on the official record plans filed in the office of the state engineer of Colorado (the plans being dated July 15, 1919; the protest Sept. 18, 1920; and the approval of the plans as of March 21, 1921, being signed "Addison J. McCune, State Engineer"), Mr. Mann mentions "a discrepancy between the elevations of the spillway" and the "crest of the dam as staked out by Chase & Barto and as shown on their plans." He says:

> The changes on this sheet are due to the fact that the undersigned assumed the previously mentioned plans and surveys were substantially correct, and, because both time and help were limited in making surveys for the revised plans, did not make the revised survey of spillway until after construction was well under way. The above noted discrepancy was then found, and to correct it and make the dam safe, the changes shown on this sheet were made and staked out on the ground by me, in accord with the specifications, and well in advance of construction at the levels involved. Neither the company nor contractor would agree to the change although fully advised that the dam would settle perhaps 5 ft. after filling, and that with much spillway discharge and simultaneous south winds, the dam will be overtopped. The state engineer was likewise fully informed as to all facts in the case, but required no change. I absolutely decline to accept any degree of responsibility for any future damage the dam may suffer by reason of failure of company or others concerned to have indicated changes made when they were possible, or in the future, nor for failures to build rockfill toe or line tunnel as provided for in my plans and specifications.

While awaiting fuller details there are given below telegraphed reports on the failure from A. J. McCune, state engineer of Colorado, who was consulting engineer for the dam when it was built; from John E. Field, representative of Mr. McCune at the scene of the failure; and from O. N. Floyd and Barton M. Jones, Pueblo representatives of the Dayton-Morgan Engineering Co., who visited the scene of the failure:

Mr. McCune — Dam break due to settlement cracks. Water was 2 ft. below spillway and 13 ft. below dam crest at time of break. Break occurred at 3 p.m. At 5 p.m. had discharged 18,000 acre-feet. Apishapa Creek at Arkansas River, forty miles below dam, discharged about 60,000 sec.-ft. and was 3 ft. below flood crest of 1921; at La Junta was about 14 ft. below 1921 flood.

John E. Field—Failure probably due to settlement cracks. Previous maximum filling, 20 ft. below spillway. No lives lost. Financial loss about $1,000,000.

O. N. Floyd and Barton M. Jones—Dam 70 miles southeast of Pueblo and 35 miles south of Fowler. Outlet tunnel 10 x 11. [10 x 10½ ft., according to Mann article, and built to deliver 2,000 sec.-ft. to satisfy prior water rights], through rock in West bluff, partly lined with concrete. This tunnel, with gates and tower, undamaged.

Spillway 10 ft. [Mann article, cited above, says 7.8 ft.] below top of dam and one mile from dam, through natural gap. At time of failure water was stationary 10½ ft. below top of dam. Previous high stage, which occurred last winter was 10 ft. lower.

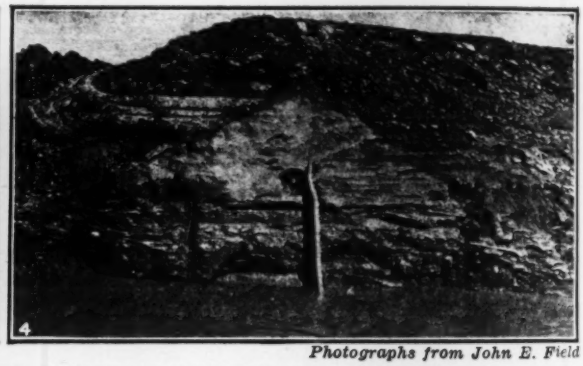
Flood caused by cloudburst in headwater region without excessive rains near basin.

Fill placed by wagons in layers of 1 ft., sprinkled and rolled with smooth concrete roller weighing one ton per foot width. Lower 60 ft. built of earth taken from valley bottom, balance taken from high ground east of dam. Small part of valley material was left in west upstream toe and appeared to be fairly well saturated. Small amount of upland material left at each end of dam appeared to be finely powdered, earth containing some sand and gravel. Water had penetrated this material 5 ft. at a depth of 20 ft.

Dam was being watched by the owner's chief engineer, who had a large crew on hand because of small leaks underneath at each end, about 25 ft. below the top. These leaks had given trouble last year, but had been practically stopped before the failure occurred. When all danger was considered past a large flow of water was discovered entering the dam at the water surface near the east end. A few minutes later a muddy stream the size of a man's body burst from the downstream slope near the west end at about 35 ft. below the top of the dam. In spite of all efforts to stop the inflow it increased very rapidly and it was soon apparent that the water entering at the east end was the same water coming out of the downstream slope at the west end. A caving in of the top soon exposed the diagonal flow through the dam. This open channel flowed several minutes before the general failure began.

The workmen left the dam at 3 p.m., when the flow was beyond control. At 3:45 the water surface in the reservoir bed had fallen 2 ft.; at 4 p.m. it had fallen 3 ft. and during the next thirty minutes it dropped 25 ft. This 25 ft. represented a storage of 9,300 acre-feet or half the original contents, discharging at an average rate of 225,000 sec.-ft. During the next fifteen minutes the water level dropped 13 ft. which left a storage of 3,600 acre-ft.

The narrow rock canyon continues about a mile below the dam. At a point 1,000 ft. below the dam the maximum high-water mark was 45 ft. above the creek bed. Below the canyon the flood plain widened to a mile and a half in some places with a maximum depth eleven miles below the dam of about 15 ft. The flood reached this point at 5:20 and at 8 o'clock it reached the railroad bridge near Fowler, 35 miles below the dam. Here the railroad embankment acted as a retarding dam and reduced the flow, already greatly modified by the valley storage, to 50,000 sec.-ft. The flood wave continued down the Arkansas River at about four miles per hour.



Photographs from John E. Field

VIEWS OF APISHAPA DAM AND RESERVOIR, COLORADO, BEFORE, AT INCEPTION OF AND AFTER FAILURE

1. Part of upper slope with water surface at about 76 ft. as shown by gage on outlet tower at left. Gage reading at time of break was 83 ft.
2. Water coming from lower slope of dam, near west end, at beginning of failure, about 3 p.m., Aug. 22.
3. After the failure: looking downstream. Remains of dam above water level show at each end. Note cutoff wall at right end.
4. East end of what was left of dam after failure, with concrete cutoff wall that was carried up and into canyon side and projected into earth dam. Also shows cast-iron drain pipe.

No loss of life has been reported and the property damage [below the dam?] is much less than would be expected. None of the numerous diverting dams along the Arkansas River was destroyed.

The foregoing information was gathered from personal inspection of the site of the dam and valley and from interviews with persons who saw the failure and some who were familiar with construction of the dam.

The dam was the property of Apishapa Consolidated Irrigation Co. It was constructed under the general supervision of the state engineer and it is apparent that care was exercised to obtain a first-class job.

Letters to the Editor

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Am. Soc. C. E. Nominations

Sir—May I call your attention to one error in the report printed on p. 319 of *Engineering News-Record* for Aug. 23, showing the result of the second ballot for official nominees of the American Society of Civil Engineers, canvassed Aug. 15?

In District 1 the two candidates for the office of Director were both to be voted for, as there are two vacancies to be filled. Paul G. Brown received 455 votes out of a possible 551—the total number of members who voted in that district. Thaddeus Merriman received 513 votes from the same 551 members. Since these men were not in competition with each other, the addition of the figures to show a total of 1,006 is misleading.

JOHN H. DUNLAP,
Secretary Am. Soc. C. E.

New York, Aug. 24.

Street Docks for Parking Cars

Sir—Referring to the enclosed clipping, and the author's suggestion that "traffic officials take the attitude that parking spaces should be so arranged as to accommodate the greatest number of cars," etc., why not, instead of painting white lines on pavements (which few drivers heed when parking) build out from the curbs at the proper angle and at curb height, concrete barriers, thus giving the curb line plan a "harbor appearance" like that of the Hudson and East River pier lines, only with greater uniformity. These permanent "berths" can be rented by the city authorities to motorists on some similar basis to that charged by pier-owners for the use of their piers by the ships which dock at them. Car owners who want to store their cars all day in front of some one's place of business, to the latter's inconvenience, and perhaps his financial detriment, would pay a storage charge in proportion to the time they occupied the berth, and thus a premium would be put on getting out quick, and keeping on the move for there would be no "free parking" in the congested area or district. Of course the rates would also have to cover a sort of "time-lock," like a slot machine, on the curb. Man drives into the berth, slips the chain of the time-lock through front wheel and hooks the free end into its proper place in the time-lock which starts the time mechanism, comes back in an hour, wants to go, dial shows amount due, say 50c. puts in money same as in telephone, chain releases, and he can get away. The "perambulating inspector" finding anyone using berth without tying up to the time-lock has the cheater arrested and fined for beating the city out of its revenues, etc. Thus we have it all simplified—the congested area is relieved of the "dead-storage" problem, and the expense of supervising "limited" parking is borne by the man who causes the expense, etc. (You sell the idea to the city authorities and we'll organize a company to build the time-lock devices and we'll either sell them on a royalty basis or rent them for a fixed annual fee, same as slot machines are handled.) Insurance companies ought to like this because it would reduce the stolen car risk, and I'll bet there's many a car owner willing to pay for a place to park.

(No! This isn't the result of "the hot weather," and I own a car, too.) But we both know of men who have made a lot of money out of less worthy ideas than this, and maybe some one will out of this. It has its possibilities.

Seriously, though, something ought to be done to straighten out this parking problem. Yes, it's getting so that the average motorist in a big town is as bad off as Noah's dove, which we are told found no place to park and so returned to the home garage. So if you, in your search for solutions to traffic engineering problems, can use this idea—go ahead.

A. NONYMOUS.

Washington, D. C., Aug. 16.

Using a Bridge to Brace Its Abutments

Sir—Some fifty or sixty years ago William F. Ellis, of Ashland, Mass., widely known in railway engineering circles, was chief engineer of a western road. He once had occasion to change the plans of a road crossing from grade to overhead, which in turn called for changing a near-by river bridge from through to deck construction. The bridge had a span of about 200 ft. One of the resident engineers presented a very low estimate of the cost of this change, and in explanation produced a sketch which showed retaining walls about 20 ft. high, so thin as hardly to carry their own weight. The resident engineer's attention was called to the doubtful strength of the walls, and their relation to the thrust of the embankment. He said in explanation, "The end of the deck bridge will take care of that, all right." Mr. Ellis looked at his assistant for a moment rather sternly, and then said, "Young man, I am unfamiliar with your practice out here; but in my part of the country abutments are built to support bridges. Not a bridge can be found carrying its own abutments." X.

Shelter Island, N. Y., July 21.

Highway "Distant" Signals at Crossings

Sir—In Ohio, and elsewhere as far as my observations have been made, the danger signals along the highway have in general corresponded with what in railway signaling is known as the "home" signal. Apparently the idea of placing a variety of danger signals very near the railroad has held too long. The vehicle on the pavement is no longer horsedrawn, and the old crossarm or its nearby assistants do not inform the motor vehicle sufficiently in advance.

My proposition is to place one, two or three series of "distant" signs for the motor driver to read. These may vary with circumstances but where possible the arrangement would be to place one series of three signs, one 500 ft., another 1,000 ft. and the third at 1,500 ft. from the track. Each series should consist of three separate signs with all lettering horizontal, the signs to be placed generally on the right side of the road, or where lights strike them at night; the first sign to read "DANGER"; the second "RAILROAD" (if two railroads or more are parallel or cross the highway near each other this would be varied as "3 RAILROADS"); the third sign to read "1,500 FT." if three series as above indicated were used.

The individual signs should be not closer than 50 and preferably 75 ft. apart (or more) and the sign carrying the distance information should be that distance from the first railroad to be crossed.

I suggest signs having letters 24 in. high and the individual words or phrases to measure 10 ft. long. The signs should therefore measure 36 in. by 12 ft. The character of letters should be plain capitals with from 4 to 5½-in. stroke.

White backgrounds with black letters on wooden signs, made with a slight water-table above and half-round strip on sides and bottom, and supported by two posts of durable wood but light section, would in general be the construction. The signs should be erected so as to clear from 48 to 60 in. above the pavement (clearing ordinary weeds and snow-drifts) but in special places they might be much higher or even lower than the highway, depending upon gradients and positions of the light shafts.

I have recently painted on highways danger signs of the above description with letters 24 in. high and of 5½-in. stroke, but abbreviating the "RAILROAD" to "R.R." or "2 R.R.'S," etc. There is no way of permanently marking these letters on the pavement however, and the zone-marking

white paint discolors to a yellow if placed on tar. For this reason I propose the sign on the side of the road, wholly free from advertising or state-highway marking, and in two or three series as stated above.

The Ohio highway department has painted white strips to correspond with two rails across the highways at certain places. This I believe is good practice but would be better if the strips paralleled, as nearly as practicable, the railway. One would then know in what directions to look for a headlight.

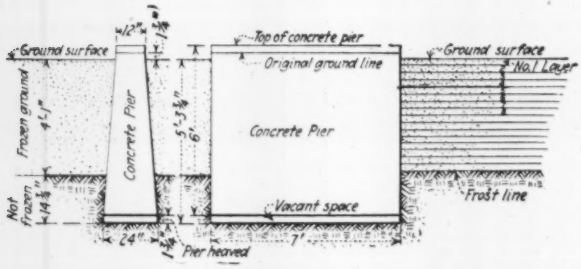
I am offering this plan to meet the grade-crossing menace; it is a "distant" signal to careful and careless alike whether driving at 15 or 50 miles per hour.

It is not intended to replace the home signal or signals, stationary, reflecting, swinging, flashing or bell ringing. I believe, however, that the plan contemplates an inexpensive addition to existing signals at a fair percentage of the grade crossings.

Columbus, Ohio, Aug. 16, 1923. V. A. EBERLY.

Action of Frost in Heaving Concrete Piers

Sir—Last March we were notified by the manager of our Montreal plant that one of the concrete piers supporting a shaft and hot air duct outside the main motor house had been raised 1¾ in., apparently by frost action. This pier had been constructed during the previous summer. It was 7 ft. long and tapering in section from 2 ft. wide at the base to 1 ft. wide at the top, and set in the ground to a depth of 5 ft. 3¾ in. as shown in the accompanying sketch. As the form of the pier was intended to prevent just such heaving by frost, and as the depth of the bottom was considered to be well below the usual frost penetration, I immediately had an investigation made to determine if possible the cause and to see just what had occurred. The ground in which



SECTIONS THROUGH CONCRETE PIER TO ILLUSTRATE EFFECT OF FROST ACTION

the pier was built is a heavy, tough, sticky clay of a grayish brown color, frequently known as gumbo. At this point it was kept well saturated by the drip from a nearby steam trap which was unable to escape on account of frozen ditches.

In digging down alongside of the pier we found the ground frozen solid until it was almost like sandstone to a depth of 4 ft. 1 in. below the surface. Beyond that point there was no frost and the wet, sticky clay could be scooped out by hand. Underneath the pier we found a vacant space 1¾ in. deep which clearly indicated that the pier had been raised bodily for that distance above its original bed.

The theory that we have to advance is as follows:

Imagine the ground to be laminated, and for the sake of argument we will say each layer of earth is 1 in. thick. As the winter advanced, layer No. 1 at the surface of the ground froze and at the same time it froze to the sides of the pier. As winter advanced still further, layer No. 2 (which was also saturated with water) froze, and, in freezing, it expanded and pushed layer No. 1 up, breaking the bond between layer No. 1 and the sides of the concrete pier. So this action proceeded, until the ground was frozen to a depth of possibly 3 ft. Then a thaw occurred. During the thaw the melting snow on the surface then found its way down between the frozen ground and the sides of the pier. Immediately following the thaw, which only lasted long enough to melt the snow on the surface of the ground, came freezing weather, at which time the water between the frozen ground and the sides of the pier froze solid, and bonded about 3 ft. of frozen earth to the sides of the pier. As the cold weather continued, this freezing action was repeated, but this time when a layer of earth an inch thick would freeze and expand, instead of breaking the bond between the frozen ground above and the sides of the pier, it would lift both the frozen earth above it and also the concrete pier, as the bond between 3 ft. of frozen ground and the concrete pier was greater than the weight of the pier and the frictional resistance of the 1 ft. 3¾ in. of soft clay against the sides of the pier under the frozen ground. As the freezing continued, this action was repeated until the pier was finally lifted 1¾ in. out of the ground.

The fact that the pier did not heave out of the ground until the end of February or March tends to confirm this theory.

One often reads specifications to the effect that all foundations shall extend below frost line. Such a specification is undoubtedly satisfactory in the case of a heated building, but in the case of isolated piers and non-heated buildings I am convinced that such wording of specifications allows for very little protection against heaving.

In view of the fact that I have not been able to find any satisfactory explanation of frost action on foundation piers in textbooks and technical magazines, I am forwarding the results of our investigation and our conclusions in the hope that you will give us your views on the subject.

Montreal, June 6, 1923. L. DEB. MCCREADY, Chief Engineer, Canadian Explosives, Ltd.

[In considering this case of frost action on foundation piers, described by Mr. McCready, it should be noted that the pier in question is unusual in that it supported only a light timber framework carrying a 3 1/8-in. shaft and a 10-in. hot air duct inclosed in a light wooden box. Consequently the heaving action of the frost only had to raise a little more weight than the weight of the concrete pier itself. For such piers a spread footing with the top of the spread footing well below frost line, properly reinforced for tension between the body of the pier and the spread footing, would probably prevent heaving. In constructing such piers the surface area exposed to the freezing ground should be reduced to the minimum.—EDITOR.]

A Remedy for Wearing of Earth Shoulders

Sir—A subject of much interest is that of a method of preventing the earth shoulder from washing or wearing away from pavements. Everyone knows the inconvenience and danger to traffic caused by this condition yet its elimination does not seem to the writer to present economic or structural difficulties.

This condition can be eliminated without additional cost above that estimated for the pavement. Suppose it is decided that an 18-ft. pavement will accommodate traffic over a certain route and that the pavement is to be of concrete. If instead of constructing a concrete pavement 18 ft. wide a width of 12 ft. were constructed of concrete in the middle of the roadway, and this flanked on both sides by clay-bound or water-bound macadam of such width as can be built with the money saved by cutting the concrete down to 12 ft., a pavement could be constructed of sufficient width to be safe without costing any more than the standard 18-ft. pavement. The concrete section would accommodate the traffic in a single lane and the macadam sections would be used in meeting and passing.

E. D. FRY, Resident Engineer, South Carolina Highway Department.

Columbia, S. C., Aug. 23, 1923.

News of the Week

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

News Brevities

"Harding Highway" Is the Name given by the Board of Chosen Freeholders of Salem County, New Jersey, to the Pennsgrove-Malaga road, in commemoration of the late President Harding, who last spring passed over this road enroute from Washington to Atlantic City.

Surveying for a Branch Line of the Canadian National Rys. from Brule, Alta., to Grande Prairie, a distance of 200 miles, has been started. This will give settlers in the Peace River country a direct connection with the Pacific and will tap important coal deposits on the Smoky River, the Bay River and Sheeps Creek.

Upon the Recommendation of its engineering staff, the Federal Power Commission has approved the application of the Pike Rapids Power Co. for a license to develop power at Pike Rapids on the upper Mississippi about 70 miles north of St. Paul and has rejected the conflicting application of the Little Falls Water Power Co. The project will develop approximately 24,000 hp.

Addition of a New 10,000-k.w. turbine unit at the plant of the Oklahoma Power Co., on the Arkansas River, across from Tulsa, at an expense of $600,000, will bring the total capacity of the plant to 30,000 kw., according to Fred W. Insull, president of the Public Service Corp. of Oklahoma. Work on the new installation will start within a few weeks.

Contracts for Two More Hydro-Electric developments in Canda have been awarded. That for the Southern Canada Power Co.'s new 30,000-hp. plant at Hemming's Falls, near Drummondville, Que., has been awarded to the Foundation Co. of Canada, Ltd., and that for the Hollinger Consolidated Gold Mining Co.'s 25,000-hp. plant at Island Portage on the Abitibi River in Northern Ontario to Sir Wm. Arrol, Ltd., of St. Catherine, Ont., for the dam and power house, to the Dominion Engineering Co. for turbines and to the Canadian General Electric Co. for generators.

The Alaskan Engineering Commission, the organization which constructed the government railroad in Alaska and now has charge of its operation, will hereafter be known as the Alaska R.R., according to an announcement of the Department of the Interior. This change will eliminate considerable confusion which now exists due to the similarity of the two names, the Alaskan Engineering Commission and the Alaskan Road Commission; the latter commission being under the supervision of the Secretary of War and charged with the construction and maintenance of wagon roads in Alaska.

Part of Nutley Zoning Ordinance Held Unconstitutional

Following closely on a decision of the New Jersey Supreme Court, by Chief Justice Gummere, that a prohibition of two-family dwellings in the zoning ordinance of Westfield, N. J., is illegal (see *Engineering News-Record*, Aug. 16, p. 281) Judge Katzenbach of the same court has ruled against the portion of the zoning ordinance of Nutley, N. J., under which a building permit for a store in a restricted residence district was refused. In essence, the last-named judge held that the property owner would be deprived of a constitutional property right under an interpretation of the police power which is contrary to the opinion of the judge as to what that power includes.

Toronto Faces Large Expenditure for Improvements

The city of Toronto, Canada, has just been appraised of the fact that during the next few years it must face an outlay of approximately $60,000,000 for special purposes. The information was contained in the annual report of Finance Commissioner George H. Ross. Included in the prospective items of expenditure were: Money to be paid for the street railway which was recently taken over by the corporation; the city's share of the cost of a railway viaduct on the waterfront and the grade separation in the northwest section of the city; consolidation and extension of the municipally-owned light and power system; extensions and new equipment for the transportation system; duplication of the water-works system.

Building 125-Mile Transmission Line in Northern Ontario

Work has been started on the 125-mile transmission line from the new power plant of the Des Quinze Power Co., a subsidiary company of the Northern Canada Power Co., on the Des Quinze River in Quebec to Porcupine, Ont. The power line is to be built with steel towers and with transformer stations at each end and stepping-down stations at the various mining camps in the Porcupine area which it will serve. It is expected that the construction parties will be able to erect ½ mile of line a day, employing up to 1,000 men on the work. If this is done the transmission line will be completed at about the time that the machinery will be delivered at the new power plant. The estimated cost of the transmission line is $1,500,000.

The initial installation at the Des Quinze River power plant will be two units of 10,000 hp. each. C. F. Goodall, who built upwards of 1,000 miles of transmission line for the Ontario Hydro-Electric Power Commission, is in charge of the work.

Work Assailed for Removal of A. P. Davis

Civil Service Reform Leader Questions Secretary's Right to Replace Reclamation Director

Authority of Secretary of Interior Work to abolish an office in the classified civil service list and to appoint to that office, by a mere change in title, a man lacking in any civil service status, is seriously questioned in a letter from William Dudley Foulke, president of the National Civil Service Reform League, to Dr. Work. The letter, made public Aug. 27, goes into the details of the summary dismissal of A. P. Davis, as director of the Reclamation Service, and the appointment of D. W. Davis as commissioner.

Mr. Foulke suggests that the change was one of political expediency and not the replacement of an engineer by a banker to effect a business administration in the service. After discussing the comparative qualifications of the two men, Mr. Foulke asks:

"Can you wonder that to many it seems that your statement of Aug. 15 that the problems of water users could be 'best handled by a practical business man,' alludes rather to the business of politics than to any other business, and that there is a fear that the public interest will be sacrificed to the demand for men useful to the party, not only among the farmers and water users, but also in the next convention and campaign?

"You once stated to me that 'other things being equal, Republicans should be appointed to places under a Republican Administration.' Are you not now extending that principle so as to make it provide that a serviceable Republican politician should be appointed whether other things are equal or not?"

RESIGNATION OR DISMISSAL?

"Was Mr. Davis's resignation voluntary or requested? Was he not informed by you on June 16 that you had decided to give his place to another man, and did you not then request him to send in his resignation to take effect June 30?

"Did he not, accordingly, write you that in pursuance of your suggestion he so tendered his resigation, and did you not thereupon object to his statement that the resignation had been requested and say that you would prefer that it should appear that it had been initiated by himself and that surely he would not desire to advertise the fact that he had been 'fired'; and did he not answer that he desired the world to know the facts, whatever they were? Did he not afterward write you that he had reconsidered his decision to eliminate those words, concluding that he would thereby be making himself party to a public deception?

"If your reasons for his removal were wholly for the interest of the service and were not political, why did you wish thus to deceive the public?

(*continued on p. 363*)

Private Capital May Develop Ohio River Power

Though Denied Application for Federal Dam Project, Louisville May Yet Control Private Enterprise

Washington Correspondence

The Federal Power Commission has granted a preliminary permit to the Louisville Hydro-Electric Co. to develop power at the proposed government dam at the falls of the Ohio near Louisville and has rejected the application of the municipality of Louisville for similar rights. This action is the result of the recommendation of the engineering staff of the commission and closes a long argument as to who should develop power at this site—Louisville or private capital.

The engineering report points out that this development is of little value unless it has auxiliary power to supplement it and that the city, in order to make it a paying proposition, would have to build an auxiliary steam plant as well as a complete distributing system, or else would have to take over the property of the Louisville Gas & Electric Co. by condemnation proceedings. In either case the amount of money required would exceed the present bonding capacity of the city of Louisville, and would consequently require an act of the state legislature before the bond limit could be increased.

The engineers further point out that the Louisville Gas & Electric Co. has the necessary distributing system and steam auxiliary. Moreover, the proposed power development is feasible only as an adjunct to navigation development on the Ohio River, and as this navigation development must be started within a year, since it is part of the remaining gap to provide 9-ft. navigation in the Ohio from Pittsburgh down, it would be impossible for the city of Louisville to get through the necessary legislation in time to start the development.

The report still further points out that the city has legal authority to regulate rates and can therefore protect itself, and that whenever it is able and ready to condemn and take over the properties of the Louisville Gas & Electric Co., it can take over this hydro-electric development as well. Therefore, the rejection of the city's application does not deprive the municipality of the right to go into the power business whenever it is ready to do so.

Since the Louisville Gas & Electric Co. did not promptly accept its preliminary permit the Federal Power Commission has advised the mayor of Louisville that it will hold up the execution of the permit until Sept. 6 to afford the municipality an opportunity to present additional arguments in favor of municipal development.

Construction Started on Merced River Dam

All bids on the construction of the Exchequer dam on the Merced River for the Merced Irrigation District have been rejected and the work will be done on the day labor plan by the district under the supervision of Thebo & Anderton, construction engineers of San Francisco. Work has already been started on foundation excavation in the expectation of taking advantage of the next low water season in placing the footings. The dam will be 310 ft. high above the river bed, the total height not being definitely known until the foundation exploration is complete, but it will not greatly exceed the height mentioned because good foundation is known to be near the surface at this point. The construction period is expected to occupy about two years.

The construction of this reservoir will necessitate the relocation of about 17 miles of the Yosemite Valley R.R. and estimates are now being made on grading and other work involved in the railroad relocation.

New Tunnel to Be Built in San Francisco

The San Francisco board of supervisors on Aug. 20 approved the construction of the Eureka Valley tunnel, a vehicular and railway tunnel, 1,634 ft. long, near the Twin Peaks tunnel, which will open up a direct route from Golden Gate Park and the Sunset district to Market St. and the Mission district. The bore is estimated to cost $1,368,107 of which the city has voted to pay 25 per cent, the remainder to be paid by an assessment on benefited property.

A. G. C. Organizes in Denver

A chapter of the Associated General Contractors of America has been effected in Denver Colo. This new concern will be known as the Rocky Mountain branch and it will comprise the states of Colorado, Wyoming and New Mexico. The officers are: Alex Simpson Jr., president; Major W. R. Richards, executive secretary; Maurice Levy, vice-president; Fred C. Dreher, secretary-treasurer. The board of directors: F. J. Kirchhof, C. S. Lambie, Peter Seerie, J. Fred Roberts, J. Everett Young, all of Denver, and Fred Bullen, of Pueblo. Major Richards has had extensive service in railroad, water works and general building construction, and was at one time associated with the J. G. White Engineering Corp., of New York, leaving that concern to enter service during the war.

Headquarters for the Rocky Mountain branch are at the Architects and Builders Exchange building, 1735 Stout Street.

Akron Votes to Transfer Power of City Manager to Mayor

By a majority reported as "exactly 100" in a total vote of "more than 14,000," or "only a small per cent" of those entitled to cast a ballot, the voters of Akron, Ohio, on Aug. 14, adopted a series of charter amendments abolishing the office of "chief administrator" (the local charter designation for city manager) and conferring the duties of the office on the mayor. The charter was adopted Nov. 5, 1918, by a vote of 11,584 to 6,233.

When the charter thus amended went into effect on Jan. 1, 1920, the city council appointed William J. Laub, mayor elect, as city administrator, and the president of the council became mayor. Two years later, after a "bitter fight," a new council displaced Mr. Laub by Homer Campbell. In the September following Mr. Campbell resigned, stating that he was "undesirable to the city political bosses," and P. Tucker was appointed in his place. The salary of the city administrator was $10,000 a year while Mr. Laub was in office and has been $7,500 since. The salary of the mayor has been $3,600 a year but with the transfer of the duties of city administrator to the mayor it will be $7,000. The chief administrator was appointed by the council. He appointed a civil service commission and most of the department heads.

The population of Akron in 1920 was 208,435, as compared with 152,559 for Dayton and 137,634 for Grand Rapids, Mich., the two ranking cities with city managers. On Jan. 1, 1924, the council-manager plan will go into effect at Cleveland, Ohio, the population of which in 1920 was 796,841.

Don Pedro Reservoir Fills Promptly

THE reservoir behind Don Pedro Dam on the Tuolumne River in California, recently completed in a twenty-two months rush construction program, filled, as did the Hetch-Hetchy reservoir which is farther up the same stream, within a few weeks after closure was made. The Don Pedro Dam is 282 ft. high and was built jointly by the Turlock and Modesto Irrigation Districts for storage purposes. A comprehensive description of the construction plant was published in *Engineering News-Record* June 1, 1922, p. 896.

Army Engineers Hear Plan For Bridge Over Hudson

Clearance Height and Safety To Navigation Are Principal Topics Discussed

On Aug. 27 a public hearing was held at New York by a board of Army engineers headed by Col. H. S. Newcomer on the project of the North River Bridge Co. for a suspension bridge across the Hudson from 57th St., New York, to the Weehawken heights. The plan submitted by the company provides a main span of 3,240 ft. between centers of towers and side spans of 1,590 ft. on each bank with a clearance height of 150 ft. on a 500-ft. width, 145 ft. on a 1,500-ft. width, and 135 ft. near the towers. The towers are steel structures enclosed within a masonry protecting shell, resting on piers 200 x 400 ft. seated each on 80-ft. cylinders sunk to rock by open dredging. The superstructure comprises two superimpose eyebar chains on either side of the deck, 160 ft. apart, with trussing of verticals and diagonals between the two chains. The deck is 235 ft. wide and has two levels, the upper for highway and the lower for railway traffic; it is carried on stringers extending between steel plate-girder floorbeams 35 ft. deep by 225 ft. long, built with six rectangular openings through the webs, each long enough to pass two tracks of the twelve railway tracks of the lower level.

Col. Newcomer stated that the hearing was concerned only with matters affecting navigation, including clearance height and safety. Span width was not considered as the pier locations are inside the pierhead lines. In addition to many letters supporting the project several were presented in opposition, including two by engineers, R. S. Buck and W. L. Saunders, the former urging that the traffic of the highway deck would congest the streets of New York and that the structure proposed is of unprecedented character.

Interstate Traffic Discussed

Speakers in support of the bridge projects discussed the needs of traffic between New York and New Jersey in various aspects. Opposition discussion centered on the question of clearance height. Col. Newcomer stated that six or seven steamships would require a clearance height of 225 ft. to pass their masts, and some 30 others would require more than the 150 ft. proposed. Representatives of lines operating large vessels claimed that the location at 57th St. would restrict the use of the new piers for maximum ships at 46th St., and that for the purpose of docking at flood tide the bridge should be a clear distance of a mile above the piers unless its clearance height on the full width were greatly increased. They admitted on question, however, that masts and funnels could be arranged to be lowered when necessary. The 135-ft. precedent set by the permits for the Brooklyn bridge and the new Philadelphia bridge was declared inadequate and hampering by members of the board. Questions of the board were directed repeatedly to the point whether tunnels would meet the traffic needs of the two sides of the river, with generally negative response.

For New York City R. F. Keller presented the views of the Dock Department and A. S. Tuttle, chief engineer, spoke for the Board of Estimate. Plans are under way for new large-size piers at 50th St., Mr. Keller stated, and the northward extension of pier construction is likely to progress farther. The problems of street congestion and proper distribution of the bridge traffic, said Mr. Tuttle, will be considered by the city at a later stage, when detail plans are presented by the company.

It is expected that the decision of the War Department on the application for approval of the plans will not be rendered for several weeks.

Consulting Engineering Organizations Affiliate

George B. Nichols, consulting engineer, 300 Madison Ave., New York City, and The Terrell Croft Engineering Co., of which Terrell Croft is directing engineer, of 6600 Delmar Boulevard, University City, St. Louis, Missouri, have effected an affiliation whereby the experience and resources of each organization will be available to the clients of the other. Nichols will act as the principal for projects east of Illinois, whereas the Croft organization will so act for projects west of that state. The combination will, as have its components in the past, specialize in mechanical and electrical engineering for power and industrial plants, institutions and buildings.

Work Assailed for Removal of A. P. Davis

(Concluded from p. 361)

"You say that no diminished construction program is anticipated, but rather an increased and accelerated construction, and that the same chief engineer now is at the head of the work. But if these vast projects are still before you, ought they not still to be under the direction of the experienced man who had begun them—a man who was then offered and is now earning in private employment far greater compensation than that received from a Government which he was patriotically serving to his own pecuniary loss?

"You say you offered him an appointment as consulting engineer. Was not this offer made on condition that he would omit the statement that his resignation as director was requested? And did you not warn him of the consequences to himself if he refused to omit that statement? Why did you do this? Did he not request of you a written statement of the reasons for his removal, and did you not answer that he was not entitled to such a statement under the law?

"You say advice to the farmers was needed regarding the subdivision of large landholding, getting more settlers, securing industrial enterprises, more intensive farming and co-operation in handling and marketing products by men trained along these lines. Is not such service now being rendered by men trained along these lines in the employment of the Department of Agriculture?

"If you were looking for business qualifications, did you appoint a man who had been successful in business? Was the bank of which Governor Davis was the organizer and president markedly successful? Was it not rather to politics that his principal activities have been devoted? Had he not been a candidate for other Federal appointments?"

Pinchot Makes Last Effort To Avert Coal Strike

Unless Compromise Plan Is Adopted, Miners in Anthracite Fields Will Strike Sept. 1.

After having failed to come to any agreement either in the extended Atlantic City conference or in the subsequent conference in New York City attended by members of the U. S. Coal Commission, anthracite operators and miners are still deadlocked on vital controversial issues: the wage schedule that is to replace that which expires Aug. 31, and the checkoff. Unless speedy and effective measures are adopted the country will face a stoppage of all anthracite mining Sept. 1.

Meanwhile, Governor Pinchot, of Pennsylvania, called in as official referee, has been holding for the past three days secret and separate conferences with both miners and operators in the endeavor to get them to agree to some compromise plan which will avert a strike. At the same time he has been employing his own state fact-finding commission presided over by Prof. Clyde C. King, former head of the department of economics of the University of Pennsylvania and now state secretary of that state composed of industrial and economic researchers and writers, to gather data on the economic phases of coal digging and distribution. Upon such data will his decision be based.

Only rumors of the compromise plan in Gov. Pinchot's mind have been heard, the details of the plan having remained secret, but at the time of going to press the proposal is about to be given both contestants. However, it is thought that Gov. Pinchot may suggest an increase in miners' pay of 5 per cent or better, and allow the operators to reject the miners' insistance that they be granted the checkoff.

In a statement issued Aug. 30 the U. S. Coal Commission asserted:

"Should a stoppage of mining occur on Sept. 1, it will accentuate the already panic demand for anthracite and unless the buyer and the retailer representing him learn from past experience, unscrupulous wholesalers will have another opportunity to repeat their speculative activities of last fall and winter on any anthracite coal that may be on the market after Sept. 1, as well as following the resumption of mining. In the absence of any definite regulatory powers over either mine prices or wholesalers margins on the part of the state and federal authorities, the extent of such activities, and the amount of premium added by wholesalers will depend largely upon the willingness of the retailer and the consuming public to pay the prices demanded.

Tentative Value Given C. & N. Ry.

A tentative value of $485,334,029 has been placed on the property of the Chicago & Northwestern Ry. by the Interstate Commerce Commission as of June 30, 1917. Since that date the railroad company has expended $57,820,981 on road and equipment, which brings the total value of the railroad and equipment up to $543,155,010. The company's bonded debt on Dec. 31 last was $287,906,700, and its preferred stock $22,395,120, which leaves a balance of $232,853,190 or about $150 a share on the common stock, of which $145,156,344 is issued.

Random Lines

Add to Definitions

Liquidating Engineers—Second-hand machinery agents (*Engineering News-Record* advertising pages).

Kitchen Engineering — Free course conducted by domestic science experts from Antioch College as part of sales campaign for kitchen cabinets in a Dayton department store.

Packing Engineering—Department of trade journal "The Barrel and Box" devoted to methods of boxing and crating goods.

Caterpillar Engineers—Gentlemen engaged in driving tractors in clearing land. Reported in the Girard, Cal., *News*. Probably not related to "mosquito engineers" previously noted.

Vocational Engineer — "Character analyst" in Baltimore who picks "right man for right job."

Hot Dog Engineer—The last word in engineering nomenclature. Discovered by W. G. R. as a concessionaire in Fairmount Park in Philadelphia. One member of the profession who believes in advertising himself, ethics or no ethics. See accompanying illustration.

* * *

Sir—With respect to the editorial "An Explanation That Does Not Explain," dealing with the removal of Arthur P. Davis, it is evident that a weak defense of an indefensible action calls for work with a capital W.

A. W. W.

* * *

Maybe They Meant Sand-Chucks

In a book review published in an architectural contemporary appears the following: "It seems strange that the writers of books on foundations neglect to have some practical sections written by experienced digger foremen and superintendents, commonly known as 'ground hogs.'" Doubtless this accounts for the large numbers of men who may be seen each Feb. 2 emerging from excavations all over the land and hunting so diligently for their shadows.

Mud-Laden Water at Omaha Causes Water-Works Trouble

Erosion of a mud bank on the shore of the Missouri River above the intake of the water-works supplying Omaha, Neb., and vicinity, combined with a large accumulation of sediment in the settling reservoirs, both due to high water in the river, gave rise to some alarming press dispatches sent over the country last week. The following details of just what happened and how the emergency was met were sent to *Engineering News-Record* at its request by R. B. Howell, general manager of the Metropolitan Utilities District, under date of August 24:

"The Metropolitan Utilities District has been installing a 50-m.g.d. filtration plant in connection with its sedimentation basins and has also been putting in two additional pumps at the Florence station, increasing the pumping capacity by about two-thirds. This work, which is nearing completion, has necessitated certain pipe connection changes that have interfered with the regular washing of the sedimentation basin. As a consequence, the capacity of the basins for clearing the water was reduced. In this crippled condition the basins were called upon to cope with the present high stage of the river and also with the effect of the erosion of a mud bank on the west side not far above the intake. The resulting quantities of silt introduced into the basins proved the last straw, and the clarifying process broke down. There was but one thing to do in the emergency, and that was to wash the basins. This work has been carried to the point where it is possible to operate the filter plant at a rate high enough to furnish the entire consumption of the city. Now that the turbid water in the mains is being displaced by filtered water, the conditions (as to the quality of the supply) are becoming normal. It is anticipated that all consumers will be receiving an excellent quality of water by Aug. 26."

Illinois Central R.R. Will Start New Line Immediately

Construction work on the new line of the Illinois Central from Edgewood, Ill., to Fulton, Ky., will be started immediately according to the announcement of the senior vice-president of that railroad. The new line will start from Edgewood, Ill., a point about midway between St. Louis and Terre Haute, and will run due south through Illinois to some point on the Ohio River near Metropolis, where it will cross the Ohio and continue south across Kentucky to connect again with the Illinois Central system at Fulton, on the Kentucky-Tennessee border.

This new line has met with considerable opposition from certain interests in Illinois, particularly from Cairo and the surrounding territory, as that territory fears that by the construction of this second line it will no longer be on the main line of the Illinois Central. The Interstate Commerce Commission after hearing all the arguments has granted the Illinois Central permission to build the line. It will have a total length of 166 miles, will shorten the route to New Orleans by 21 miles, and will reduce the grade against coal traffic considerably. The estimated cost is $16,500,000.

European Design Prize to Honor American Engineer

A Lindenthal prize for artistic design has been instituted by the Verein Deutschösterreichischer Ingenieure. It is to be awarded each year to the best design of architectural and engineering character presented at the Behrens school of the Vienna Academy of Arts. The initial award has just been made for the design of a hydro-electric powerhouse. The prize is named after Gustav Lindenthal, engineer of the Hell Gate Arch and the proposed Hudson River suspension bridge, who was born in Austria.

Bankers Plan to Finance New York Port Development

Representatives of sixteen large financial institutions in New York City have held an informal conference with the New York Port Authority and have proposed a scheme of financing the plans for developing the port according to the comprehensive plans of the Port Authority. It is estimated that the plan will require from $100,000,000 to $200,000,000 before it is completed, but this sum will only be required in small amounts as the various units in the plan are developed. The money would be raised by bond issues secured by the actual property of the Port Authority and guaranteed by the states of New York and New Jersey. This plan is very similar to that in use in European ports, such as the Port of London, and provides a very attractive form of investment.

Steps for Large Sewage-Works for Part of New York City

Preliminary steps to acquire the right to use for sewage disposal land on Wards Island northeast of the New York Connecting Ry. have been recommended to the New York Board of Estimate and Apportionment by Arthur S. Tuttle, chief engineer, in accordance with a report of Kenneth Allen, sanitary engineer of the board. The board has concurred in the recommendation. The plan is to get permission from the Commissioner of the Land Office for the transfer of the lease of some fifty acres of land from the State of New York to the City of New York.

In his report on this subject (New York *City Record*, Aug. 15, p. 5386), Mr. Allen in discussing the degree and kind of treatment required, stated:

"The extent of treatment depends upon the steps taken to clean up the rest of the East and Harlem Rivers. The least degree of treatment to be considered would be sedimentation in tanks, but it is probable that some more thorough method, such as that known as the activated sludge process, will be found necessary. With the latest developments in this process 10 m.g.d. may be treated daily on one acre of ground, so that the 202, or at most 232, m.g.d. to be expected in 1960, would require not over 24 acres or about half the area now suggested."

The sewage to be treated on the site in question would come from adjacent areas in Manhattan, The Bronx and possibly Queens. This project is part of a tentative plan to treat as much sewage as local conditions demand.

Engineering Societies

Calendar

Annual Meetings

NEW ENGLAND WATER WORKS ASSOCIATION, Boston, Mass.; Annual Convention, Burlington, Vt., Sept. 18-21, 1923.

INTERNATIONAL ASSOCIATION OF STREET SANITATION OFFICIALS, Chicago, Ill.; Annual Conference, Chicago, Sept. 27-28, 1923.

AMERICAN PUBLIC HEALTH ASSOCIATION, New York; Annual Meeting, Boston, Oct. 8-11.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York; Fall Meeting, Richmond, Va., Oct. 17-20.

AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS, St. Petersburg, Fla.; Annual Convention, Atlanta, Ga.; Nov. 12 to 16.

CITY MANAGERS ASSOCIATION, Lawrence, Kansas; Annual Meeting, Washington, D. C., Nov. 13-15.

The San Francisco Section, Am. Soc. C. E. held an excursion and barbecue on, Saturday afternoon and evening Aug. 11, at Sunol, Calif., as guests of the Spring Valley Water Co. About eighty members and guests made the trip by automobile; inspection was made of work on the Calaveras Dam and on the new reinforced-concrete aqueduct two miles long which is now under construction in Niles Canyon. The barbecue dinner was served near the Sunol water temple, after which there was a short talk by George A. Elliott, chief engineer of the company, on "The Immediate Development and Delivery of an Additional Water Supply for San Francisco Amounting to 24 Million Gallons Daily."

The Engineering Institute of Canada has organized a branch at Kenogami in the Saguenay district, with an initial membership of 51. This branch was inaugurated through the enterprise of the Montreal branch of the institute. Officers at Kenogami were elected as follows: chairman, W. Mitchell; secretary-treasurer, H. B. Pelletier.

Personal Notes

ROBERT GILMOUR, superintendent of Montreal terminal stations of the Canadian National Rys., has been appointed assistant to the general superintendent, Canadian Nationals Rys., office at Montreal.

BRIAN R. PERRY, formerly engineer with P. Lyall & Sons Construction Co., Montreal, has joined the staff of the McKinnon Steel Co., Ltd., of Sherbrooke, P. Q., with offices at Montreal. Mr. Perry is a graduate of McGill University.

U. G. I. CONTRACTING CO. of Philadelphia, a concern engaged in contracting, construction and engineering has filed a copy of its certificate of incorporation with the Secretary of State at Albany, New York, in order to enable it to do business in this state, through A. D. Dudley of 421 South Warren St., Syracuse, N. Y., as its agent.

H. W. GREEN has resigned as sanitary engineer on anti-malaria work with the International Health Board of the Rockefeller Foundation to enter service of the Cleveland Health Council as director of the Bureau of Statistics and Research for the Cuyahoga County Public Health Association. With the Rockefeller Foundation Mr. Green had charge of a demonstration and investigation project in Porto Rico.

PROF. W. K. HATT will resume his duties as professor of civil engineering at Purdue University, Lafayette, Ind., having served two years on the Advisory Board on Highway Research of the National Research Council. He will continue to direct the affairs of the Advisory Board for the present.

R. W. HEBARD & CO., Inc. have been employed by the city of Limon, principal Atlantic port of the Republic of Costa Rica, to prepare plans for general sanitation of that city.

JAMES E. MILLER, of Chicago, has been appointed trade commissioner of the Department of Commerce at Calcutta, India. Mr. Miller was formerly a consulting engineer with the General Engineering and Management Corp. of New York City, and prior to that was engaged with the Westinghouse Electric & Manufacturing Co. in engineering construction and sales in the United States, Canada, England, France, Russia and South America.

ABRAHAM LEVIN announces the organization of the Technical Service & Engineering Co., himself as manager, in Huntington Park, Calif., for the practice of civil and industrial engineering, especially the designing of buildings for industrial plants. Mr. Levin was formerly connected with the Rider-Connolly Manufacturing Co. of Pittsburgh, Pa., and the Virginia Bridge & Iron Co., Roanoke, Va.

FRANK T. MILLER, Greensboro, N. C., has been appointed chief engineer of the proposed Appalachian & Western North Carolina R.R., which is being sponsored by the state.

W. R. WORLEY, formerly an insurance man, of The Dalles, Ore., has been appointed city manager of Warrenton, Ore., to succeed Mrs. R. E. Barrett, who has resigned on account of ill health.

FREDERICK WILLIAMS, civil engineer and surveyor, formerly assistant engineer of the New Jersey Board of Commerce and Navigation, announces the opening of an office at 336 Main St., East Orange, N. J., for general practice.

CHARLES W. MCKAY, former president and general manager of McKay & Sherman, and more recently head of C. W. McKay and Associates, valuation engineers, has been made manager of the valuation division of Roberts-Pettijohn-Wood Corp., engineers and appraisers, of Chicago.

WILLIAM H. FLAHERTY, formerly located with the Gulf Wrecking Co. at Mobile, Ala., is now a consulting engineer and contractor with office at 44 Whitehall St., New York City.

J. C. MANLEY for some years city engineer of Tacoma, Wash., has resigned, effective Sept. 1, on account of ill health.

J. ALBERT HOLMES, consulting engineer, Boston, Mass., has been selected to make an investigation of and report on flood conditions at Chickasha, Okla., and as consulting engineer on the design and construction of an earth dam at Asheville, N. C.

MCCALL-MOORE ENGINEERING CO., Waco, Texas, a partnership which has existed since 1912, will be dissolved Sept. 1, 1923, and each of the partners will remain in Waco and conduct a business along the same line, Mr. McCall under the firm name of the McCall Engineering Co., and Mr. Moore under the firm name of Bart Moore Construction Co.

HARTIGAN-PROUDFOOT CO. has been incorporated to do a general contracting and construction work at East Chicago, Illinois. Alfred G. Proudfoot, Augustus F. Hartigan and Walter E. Kasten are directors of the company.

RICHARD W. SCHMIDT, formerly a field engineer with the Roxana Petroleum Co., has been made assistant civil engineer in the sewer department of the St. Louis, Mo., board of public service.

WALTER H. FRICK, formerly architect with the West Penn Power Co., has become an assistant civil engineer with the Pressed Steel Car Co., Pittsburgh, Pa.

PROF. L. S. SMITH, professor of engineering at the University of Wisconsin, Madison, has been engaged as city planner for the city of Waukesha, Wis.

HARRISON BROBERG has resigned from the Kansas Highway Commission and has accepted a position as highway engineer with the U. S. Bureau of Public Roads in construction work in the Phoenix, Arizona, district.

GEORGE A. CRANE has been made chief estimator for the Aberthaw Co. in its main office at Boston. Mr. Crane was for five years manager of the Detroit and Montreal offices of the George A. Fuller Co.

GEORGE F. RUSSELL, superintendent of public utilities, Seattle, Wash., has been appointed superintendent of the water department, to fill the vacancy caused by the death of L. B. Youngs.

CLIFFORD A. BETTS, resident engineer on transmountain division surveys for the Denver Municipal Water Commission, has been made office engineer for the Moffat Tunnel Commission, Denver.

CLARENCE F. POST has been named purchasing agent of the Western Pacific R.R., succeeding the late William T. Jacobs, whose assistant he was. Mr. Post has been with the Western Pacific since 1916. He went to the Pacific Coast seventeen years ago as a representative of the St. Paul and Tacoma Lumber Co., and later was with the Grand Trunk Pacific R.R. at Prince Rupert, Canada.

GEORGE PERRINE, construction engineer for Rodgers & Hagerty, Inc., general contractors, New York City, is

now engaged on the construction of the New York approach of the vehicular tunnel, for which this firm has the contract. Mr. Perrine's engineering estimating and construction experience includes elevated railway and subway work in Baltimore, Washington and New York City, and charge of construction of the Cathedral of St. John the Divine in New York City.

E. J. TERRILL has been appointed division engineer of the Southwest division of the Kansas State Highway Commission with headquarters at Dodge City, Kan. Mr. Terrill was formerly resident engineer on federal-aid projects in Montgomery County.

JAMES E. BARLOW, city manager of New London, Conn., since Nov. 1, 1921, has resigned. Lack of support in the enforcement of the liquor laws is reported to be the cause of the resignation. Mr. Barlow was principal assistant city engineer of Cincinnati under H. M. Waite and went to Dayton, Ohio, early in 1914, to become director of public service under Mr. Waite as city manager. When Mr. Waite resigned in 1918 to enter the army as lieutenant-colonel, Mr. Barlow became city manager of Dayton.

C. R. RANKIN, assistant city engineer of San Francisco, who has been resident engineer on the recently completed O'Shaughnessy Dam on the Hetch Hetchy project, has been put in charge, for the city, of the construction of the 24 m.g.d. conduit that will be used for the present by the Spring Valley Water Co. to bring an additional water supply into San Francisco.

ROBERT S. SUMNER, civil engineer, with offices in the United States National Bank Building, Denver, has been appointed a member of the Denver Water Commission, relieving FINLAY L. MACFARLAND. Mr. Sumner is a member of the American Society of Civil Engineers. PETER SERIE, local contractor, has also been appointed a member of the commission, filling the vacancy caused by the death of JOHN C. SKINNER.

CHARLES A. HOWLAND has been appointed on the technical staff of the Philadelphia Bureau of Municipal Research to fill the position left vacant by the resignation of J. W. Follin. Since 1920 Mr. Howland has been estimating and construction engineer on water supply, sewerage and paving improvements for the Benham Engineering Co., Kansas City. Previous to that, since graduation from Cornell University, he was inspection engineer and then assistant sanitary engineer for the New York State Department of Health, this service, however, having been interrupted by service in France during the war with the 102nd Engineers.

LIEUT.-COL. FRANCIS A. POPE, Corps of Engineers, recently arrived at San Francisco from the Philippines, has been ordered to Norfolk, Va., for duty. Lieut.-Col. Pope was, during the war, first in command of the 301st Engineers and division engineer of the 76th Division, and in 1918 in command of the 315th Engineers and division engineer of the 90th Division. Since the war he has served at Duluth on river and harbor improvements and in the Philippines.

From the Manufacturer's Point of View

A Point of Contact Between Maker and User of Construction Equipment and Materials

To Draw for Exhibit Space at Good Roads Show Soon

Announcement will soon be made of the date for drawings for exhibit space at the annual Good Roads Show, to be held in the Coliseum, Chicago, Jan. 14-19, in connection with the convention of the American Road Builders' Association. As announced in this journal Aug. 16, p. 284, Charles M. Upham, state highway engineer of North Carolina, has been appointed manager of the convention and show and will be granted a leave of absence by the State Highway Commission of North Carolina in order to devote his time to completing arrangements for the Chicago convention and exhibit of road-building equipment and materials. Mr. Upham will open an office in Chicago well in advance of the convention date. Mr. Upham will report directly to the executive committee of the American Road Builders' Association. With the approval of that committee he will appoint several committees to handle various features of the two big events of the year in the highway industry.

President Frank Page has received from S. F. Beatty, president of the Highway Industries Exhibitors' Association assurances of that body's cooperation in making the 1924 Good Roads Show a success.

All inquiries regarding the convention and show should be addressed to the home office of the American Road Builders' Association at 37 West 39th St., New York City, until the announcement of the location of the temporary Chicago office has been made.

Barnes Cites Production Records of American Industry

Julius H. Barnes, president of the Chamber of Commerce of the United States, in an address Aug. 22 before the National Association of Insurance Agents, cited ten production records that have been established in industry during the last few months. They are: largest pig iron production; largest cotton consumption; largest steel ingot production; largest crude oil production; largest automobile and truck production; largest residential construction; largest production of locomotives; largest volume of mail-order sales; largest volume of retail sales; largest volume of railroad car loadings.

Mr. Barnes also made several significant comparisons of changes that have taken place in the United States since the pre-war year of 1913. The more important comparisons are:

"The population of the United States has increased 14,000,000 people, with their enlarged requirements.

"The annual national income has increased from 34 billion, to 50 billion dollars.

"The aggregate savings deposits have increased from 6 billion to 14 billion dollars.

"The deposits in national banks have increased from 6 billion to 17 billion."

Ten Thousandth Mixer Order Shipped by Koehring Co.

Mixer order No. 10,000, a 14-E paver, was completed and shipped Aug. 1 by the Koehring Co., Milwaukee, to the Julian C. Field Co. in Texas. The 10,000 concrete mixers have been sold by the company during the period of 16 years that it has been engaged in the production of this type of construction equipment.

Early Shipments Urged to Prevent Freight Car Shortage

Intimation of a threatened freight car shortage this fall has been given by the Public Relations section of the American Railway Association in an advisory circular just issued to trade organizations urging manufacturers to increase their efforts to expedite the movement of freight before the usual heavier shipments of the fall begin.

"The fact that there is no appreciable car shortage today should not serve as a basis for lessening the efforts to move as much as possible before the fall period," says the railway association's warning to shippers and consumers. "The volume of traffic now being handled is far in excess of that tonnage which the Car Service Division originally anticipated would be offered the railroads. To avoid car shortage this fall shippers and consumers must continue and augment during the next thirty days their efforts to level off the peak of shipments during the coming fall."

HEAVY CAR LOADINGS

The American Railway Association reports that the railroads are now moving the greatest volume of freight in the history of the country. This is being done practically without car shortage, due to increased efficiency of operations, installation of new and better facilities, active co-operation of industry and agriculture in promoting the most efficient use of transportation facilities and in moving a substantial tonnage in anticipation of future requirements.

"From the best economic analysis of business conditions which we are able to obtain," says the railway association, "the measure of the large railroad tonnage being offered is due not only to a general increase in business activity, but also to the efforts which have been put forth in some industries to stock in advance in anticipation of future needs. Notwithstanding this progress, inventories throughout the country are not extra large, and all indications seem to point to continued business activity and heavy car loadings.

"The railroads are vitally interested in discharging their responsibilities this year in the most adequate manner possible, but to accomplish this end, and minimize car shortage during the peak fall movement, nothing should be left undone at this time to move the tonnages of those commodities which can be properly stocked by consumers during the next thirty days to meet their

fall and winter requirements. This is especially true of coal, lumber, sand, gravel and other building materials, and those commodities the need of which has already been set out in definite future programs."

Paving Brick Production in July

Steady production of vitrified paving brick during July is reported by the National Paving Brick Manufacturers Association, Cleveland. The July statistical report covering 68 per cent of the normal tonnage capacity of the industry, shows production 30,529,000 and shipments 27,092,000 brick as compared with a June production of 31,105,000 and June shipments of 27,251,000. Stocks on hand at the end of July were 78,835,000 brick, as against 75,398,000 at the beginning of the month.

July shipments were made into thirty states and Canada, with Ohio leading in consumption followed by Illinois, Texas, Iowa and Pennsylvania in the order named.

Automobile Production

The Department of Commerce announces July production of automobiles, based on figures received by the Bureau of the Census and covering approximately 90 passenger-car and 80 truck manufacturers each month as follows:

AUTOMOBILE PRODUCTION
(Number of Machines)

	Passenger Cars		Trucks	
	1923	1922	1923	1922
January	223,706	81,693	19,398	9,416
February	254,650	109,171	21,817	13,195
March	319,638	152,959	34,681	19,761
April	344,474	197,216	37,527	22,342
May	350,180	232,431	*43,013	23,788
June	*337,143	263,027	*40,616	25,984
July	297,104	224,770	29,998	21,837

* Revised.

American Designs Copied Abroad

That American manufacturers need proper protection in foreign countries for their designs, patents, trademarks and copyrights is emphasized by the Department of Commerce in the following statement:

The superiority of American machinery is generally recognized in foreign countries, and in a great many instances designs have been copied and the business so handled as to work to the great disadvantage of American manufacturers. In some instances foreign interests send to this country inquiries for equipment and stipulate that detailed working drawings must be furnished with proposals—endeavoring, through one subterfuge or another, to secure full particulars of the working details. Very often it develops that this is done to facilitate their own work in producing copies.

The matter is referred to because the Bureau of Foreign and Domestic Commerce has been in receipt of further reports showing how foreign manufacturers of machinery have succeeded in securing detailed drawings enabling them to produce copies of American types of machinery. It is therefore suggested that, when foreign inquirers call for the furnishing of detailed drawings, the matter be taken up with the Bureau of Foreign and Domestic Commerce, Washington, D. C., as there is a fair probability that, through cooperation between this government agency and the manufacturers, a way will be found to meet the requirements of the situation, and at the same time overcome the risk of furnishing working drawings to a foreign competitor.

Discuss Asphalt Paving Practice at Denver Conference

By Roy J. Randall
Office Engineer, State Highway Department, Denver, Colo.

DISCUSSION at a conference on asphalt paving held at Denver, Colo., Aug. 21 and 22, and participated in by highway engineers, contractors, and producers of asphalt, was notable in the diverse opinion expressed. Many of the points brought out in certain papers were contradicted in others, the effect being to leave one at a loss as to what was considered correct procedure.

A state highway engineer said that the use of asphalt was particularly suited for paving in his state on account of the wide variety of mineral aggregates to be found locally. While these aggregates differ considerably in composition, size and quality, they can all be used with asphalt for paving with satisfactory results by changing the specifications for the mix to suit each locality. He called attention to the fact that few of these local materials, which were found to be suitable for asphalt paving, were suitable for concrete.

In contrast with this paper, another speaker made the statement that the largest single cause of failure in asphalt paving was due to unsuitable mineral aggregates. While the last paper did not entirely disagree with the first one, it emphasized the necessity of using no local material for asphalt paving unless tests had shown that material to be adequate for first-class work.

Allowable Vehicle Loads

Another point upon which there seemed to be a wide diversity of opinion was the allowable loads on highway vehicular traffic. One speaker asserted that no limit should be placed on any load on highways, and that engineers could design roadways to accommodate any load, and accomplish this result with comparative ease. Later at the conference another speaker vehemently attacked the position of engineers who were designing pavements and structures for loads of from 15 to 20 tons. He stated that, in his opinion, a load from 10 to 12 tons should be the maximum allowed on any public highway.

A large number of the speakers materially digressed from the subjects assigned to them and wandered into the field of comparison between the rigid and semi-rigid types of pavement. Some rather broad statements were made concerning the "sinful waste of public funds" entailed by those officials who continue to pave with concrete.

The writer somewhat regrets that more time at the conference was not employed in the discussions of the speakers concerning the weak points in asphalt pavement—how they might be corrected, and points which should be carefully watched in laying asphalt pavement. However, many valuable examples of special construction work were given during the progress of the conference, such as the laying of asphalt pavement between street-railway tracks and on bridge floors.

Among the speakers were J. E. Pennybacker, of the Asphalt Association, Roy M. Green, Western Laboratories, E. P. Allen, Standard Oil Co. of Indiana, C. P. Jensen, Fresno, Calif., J. A. Griffin, Los Angeles and S. H. Diggs, Midwest Oil Co.

Business Notes

H. D. Conkey & Co., Mendota, Ill., manufacturers of cranes and industrial cars, announce the appointment of the Florandin Equipment Co. as New York sales agents. The latter organization, in addition to handling the distribution of Conco cranes in the New York district, is agent for the hoists manufactured by American Engineering Co.

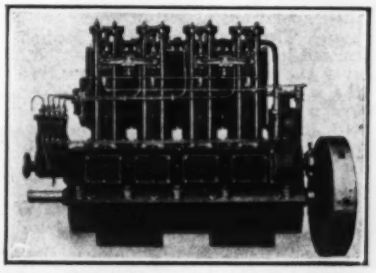
Link-Belt Co., Chicago, announces a reduction in the price of its Cub portable belt loader from $700 to $550. The machine is equipped with a two or three phase, 60-cycle motor, and fitted with raising or lowering mechanism.

Dr. Thomas Addison has retired at his own request as Pacific Coast manager of the General Electric Co. and will be succeeded by J. A. Cranston, formerly Northwestern manager. Dr. Addison has been with the company for 33 years, and has held his present position since 1892. He was born in Courtland, Mich., and was graduated from Bellevue Medical College with the class of 1877. In 1885 he forsook his profession of medicine to take employment with the United States Electrical Co. of Chicago, and in 1888 accepted a position as apparatus salesman with the Thomson-Houston Co. at that city. When the western branch of the company was reorganized in 1890 he was selected to go to San Francisco as local manager. Two years later he became Pacific Coast manager of the General Electric Co.

Equipment and Materials

Heavy Oil Engine Designed for Low Operating Costs

Economical operation, due to the use of low-priced fuels of the semi-Diesel type, kerosene or Pacific Coast distillate, together with operating flexibility, lightness of weight and bulk comparable with a gasoline engine, are among the advantages claimed by the Automatic Machine Co., Bridgeport, Conn., for its four-cylinder heavy-oil engine manu-

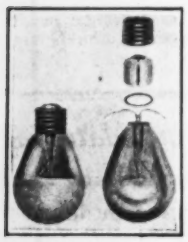


factured in sizes with a power range from 19 to 150 hp. This motor, its manufacturer claims, is particularly adapted to the operation of heavy construction equipment, such as steam shovels, locomotive cranes, hoists and other material-handling plant or may be employed as a separate portable power plant for the operation of electric generators, conveyors and other types of machinery.

The feature of the equipment is its light weight compared with other types of oil engine, amounting to about 50 lb. per horsepower. As to fuel consumption, tests indicate that about ½ lb. of oil is required per horsepower-hour. The engine operates at from 450 to 525 r.p.m., the same speed as the company's heavy-duty gasoline engine. The motor is equipped with a standard electric starter and a gear pump insures the constant flow of lubricating oil to all internal working parts. For ignition a jump spark is used instead of hot bulbs. For operation there is a moderate compression, which, however, is high enough to insure good fuel economy and at the same time low enough to prevent frequent repairs to the engine. A ball type of governor, driven by a pair of spiral gears, automatically adjusts the power to the load. The cylinders are water-cooled. Through the entire range from no load to full load the speed is controlled by the movement of the throttle, there being no other valves or levers to be regulated. With the exception of its height the dimensions of the heavy-oil engine are the same as the company's gasoline engine so that the two types of machines are interchangeable on the same foundation.

Theft-Proof Electric Bulb

To prevent theft of electric bulbs on construction work and in industrial buildings, hotels and schools, a special design of lamp which fits any standard socket has been developed and placed on the market by Lester Kulp, 143 West Austin Ave., Chicago. The main parts of the bulb, which is without guards, locks, keys or springs, are shown in the accompanying illustration. One contact is at the top, just as in an ordinary lamp, and the other through a brass ring fastened at the bottom of a porcelain plug. This plug has a groove which is filled with plaster of paris, lightly holding the brass shell in place. After the lamp is screwed into the socket an extra turn breaks the plaster of paris so that the lamp can turn freely in the shell and at the same time maintain electrical contact. The shell, however, cannot be turned in the socket. The shell is spun over the ring and screws up so close to the socket that fingers or tools cannot grasp it. The bulbs are made in standard sizes and can be removed for replacement when burned out.



An All-Year-Round Explosive

A new non-freezing exposive named "Ammite" has been announced by the Atlas Powder Co., Wilmington, Delaware. In addition to its non-freezing properties the manufacturers claim for it all the advantages of dynamite in strength, water resistance, sensitiveness and stability. The explosive is made in six grades, 75, 60, 50, 40, 35 and 30 per cent. These are claimed to be sufficient to meet practically every requirement of blasting in mines, quarries, clay pits or construction work, either above or below ground.

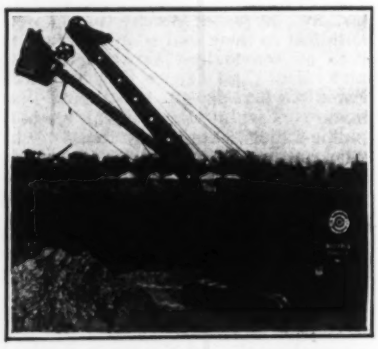
Wheeled Scraper and Leveler Built in Three Sizes

Designed for tractor operation, the Hanford wheeled scraper and leveler is being built in three sizes, 1, 2, and 4 cu.yd., by the Yuba Products Co., San Francisco. The bowl is mounted on an axle carrying two wheels in such a way that when moving into position or traveling it does not touch the ground, but when dropped into the loading position by the movement of a lever only the forward ½ in. of the blade is in contact with the earth, thus eliminating drag and reducing the amount of power required for hauling. A lever release provides for dumping, and during this operation the bowl swings into a vertical position and rolls upward in trunnions placed on either side. Dumping is controlled by a check chain on the bowl which may be set at any desired length to provide for spreading the dirt or dumping in one pile. Power from the tractor accomplishes the dumping operation.

The smallest sized scraper, with a bowl 5 ft. wide, is a one-man outfit in which the levers are handled from the driver's seat on the tractor. The other two sizes, with 6-ft. and 7-ft. scrapers, require two operators, one driving the tractor and the other on a platform behind the scraper controlling the filling and dumping of the bowl.

New ¾-Yd. Shovel Has Rope Thrust

A new ¾-yd. gasoline rope-thrust revolving shovel, known as the 20-B and embodying the same features as the company's 30-B machine which has been on the market for the past year, has just been announced by the Bucyrus Co., South Milwaukee, Wis. The feature of this machine is the patented rope-thrust arrangement which not only does away with the necessity of engines, gears, clutches, chains or complicated shafting on the boom, but at the same time gives the shovel a drive behind the thrust which is claimed to be more powerful than it is possible to obtain with a steam shovel of the same size, since the whole power of the main engine is behind it.



The shovel is driven by a single, slow-speed gasoline engine. The motions of the dipper handle are controlled by a small drum on a shaft under the boom, which shaft has keyed to it pinions for engaging with the racks on the handle. The drum is turned either way by two ropes wound around this drum in opposite directions, both ropes leading to drums in the main machinery.

This shovel may also be had with high lift or extra high lift booms, or with dragline, clamshell excavator or crane attachments. The control, according to the manufacturer, is exceedingly simple, and the machinery is arranged with convenience of the operator in mind. Whatever clutches are necessary are sufficiently large to obviate the danger of burning. The caterpillars and frame in general are the same as on the 20-B steam machine.

Publications from the Construction Industry

Test Road Results — PORTLAND CEMENT ASSOCIATION has published a 16-p. pamphlet consisting largely of pictures, with explanatory text, of the results of the traffic tests conducted by the Illinois State Highway Department on the Bates experimental road.

Cold Patch—TEXAS CO., New York, is distributing a 24-p. pocket-size booklet on the use of Texaco cold patch for repairing roads and streets. The text gives the proper proportion of stone and asphalt to be used and describes the preparation of the worn area of the pavement, the mixing and curing of the repair material and the construction of the patch.

Track Drainage—W. S. DICKEY CLAY MFG. CO., Kansas City, Mo., in a 59-p. illustrated pamphlet, sets forth in detail the uses of vitrified clay products for the drainage of railway track. A number of typical installation photographs are shown and there are drawings showing drainage details for a variety of special conditions.

Air Filters—MIDWEST AIR FILTERS, INC., New York, have just published a 49-p. illustrated pamphlet entitled "Dust Problems and Their Solution," showing the application of air filtration to a variety of industrial uses. The filters are essentially shallow steel boxes with perforated sheet metal covers and are filled with filter materials covered with a thin film of viscose fluid. Among the uses suggested for the air filter are in connection with heating and ventilating installations, cleansing air for use in sewage works of the activated sludge type, food and food product plants, paint shops, paper mills, textile mills, hotels and restaurants.

Business Side of Construction

FACTS AND EVENTS THAT AFFECT COST AND VOLUME

July Industrial Movements Shown by Government Figures

The Department of Commerce announces the following figures covering industrial and commercial movements in July:

Iron and Steel

Pig-iron production in July totaled 3,680,000 tons as against 3,668,000 tons in June and 2,405,000 tons in July a year ago.

Steel-ingot production, allowing for companies not reporting, amounted to 3,516,000 tons as compared with 3,749,000 tons in June and 2,953,000 tons in July, 1922.

Unfilled steel orders at the end of July amounted to 5,911,000 tons as compared with 6,386,000 at the end of the preceding month and 5,776,000 tons on July 31, 1922. Prices of iron and steel declined during the month.

Locomotive shipments by the principal manufacturers amounted to 239 as against 232 in June and 128 in July, 1922. Unfilled orders on the books of these manufacturers on July 31 called for the delivery of 1,738 locomotives as compared with 1,958 on June 30 and 811 on July 31, 1922.

Building Materials

The index of the cost of building materials entering into the construction of a six-room brick house, at 217 for July on a 1913 base, compares with 215 for June and 184 for July a year ago. For a six-room frame house the index for July is 214 as compared with 212 for June and 181 for July, 1922.

Contracts awarded for all classes of construction in 27 Northeastern states amounted to $274,225,000 as compared with $323,559,000 in June and $350,081,000 for July a year ago.

The production of Douglas fir in July totaled 461,532,000 ft. as against 567,626,000 in June and 476,199,000 in July, 1922. Prices of lumber and building materials declined during the month while new orders for flooring, both oak and maple, increased in July over the preceding month.

Cement Production

Production of cement totaled 12,620,000 bbl. as compared with 12,382,000 bbl. in June and 11,557,000 bbl. in July a year ago. Stocks at the end of July amounted to 8,076,000 bbl. as compared with 8,433,000 bbl. on July 31, 1922.

The total employment in 1,428 representative United States factories amounted to 2,041,250 on July 31 as compared with 2,040,827 at the end of June and 1,729,826 on July 31, 1922.

Wholesale prices in general declined, the Department of Labor index for 404 commodities being 151 as compared with 153 for June and 155 for July, 1922. The cost of living index, based on July, 1914, as 100, stood at 162 for July, as compared with 160 for June and 156 for July a year ago. The index of unfilled orders for basic commodities compiled by the Department of Commerce stood at 68 on Aug. 1, based on 1920 as 100, as against 77 on July 1 and 66 on Aug. 1, 1922.

Structural-Steel Sales

The Department of Commerce has just announced July sales of fabricated structural steel, based on figures received by the Bureau of the Census. Total sales of 113,331 tons were reported for July by firms with a capacity of 224,640 tons per month.

Tonnage booked each month by 175 identical firms, with a capacity of 229,575 tons per month, is shown below, together with the per cent of shop capacity represented by these bookings. For comparative purposes, the figures are also prorated to obtain an estimated total for the United States on a capacity of 250,000 tons per month.

1922	Actual Tonnage Booked	Per Cent of Capacity	Computed Total Bookings
April	200,588	87	217,500
May	184,638	81	202,500
June	168,498	73	182,500
July	157,631	69	172,500
August	156,011	68	170,000
September	146,146	64	160,000
October	132,450	58	145,000
November	111,794	49	122,500
December	138,024	60	150,000
1923			
January	172,415	75	187,500
February	183,938	80	200,000
March	218,997	95	237,500
April	185,335*	81	202,500
May	131,291*	57	142,500
June	116,609**	51	127,500
July	113,331***	50	125,000

* Reported by 174 firms with a capacity of 229,375 tons.

** Reported by 170 firms with a capacity of 228,160 tons.

*** Reported by 156 firms with a capacity of 224,640 tons.

Apprenticeship Courses Planned for N. Y. Building Trades

Registration will begin next month for the apprenticeship courses in the building trades in New York, as a result of co-operative effort between the Board of Education and the Apprenticeship Commission of the New York Building Congress. Through the medium of seventy night classes to be held in ten schools, an effort will be made to relieve the shortage in skilled labor by the training of young men as bricklayers, carpenters, sheet metal workers and painters.

It is understood that the bricklayers' union and the Mason Builders Association have promised their help in developing and carrying on a comprehensive apprenticeship program in the bricklaying industry. Similar movements are under way in Boston, Philadelphia, Cleveland and other cities, according to Fred F. Moran, managing director of the Apprenticeship Commission of the New York Building Congress. For the New York courses an enrollment of about 2,000 apprentices is expected.

The movement to develop apprentices by co-operation of employer, labor union and the public school system, according to Mr. Moran, is growing rapidly. It is said that employers who were formerly reluctant to take on boys to learn a trade, or who dispensed with them after a few months' trial, are now pledged to support the apprenticeship program. Recent conditions in the building industry have indicated the desirability of a steady, normal supply of apprentices to replace vacancies in particular trades. Building congresses are functioning in various cities to stabilize the industry by developing an adequate supply of skilled labor and providing steady work.

Report on Surplus Freight Cars

The railroads of the United States on Aug. 14 had 78,404 surplus freight cars in good repair and immediately available for service if needed, according to reports filed Aug. 25 by the carriers with the Car Service Division of the American Railway Association. This was an increase of 4,236 over the number of such cars on Aug. 7.

Of the total number, 56,948 were surplus box cars in good repair, an increase of 1,582 within a week, while there also was an increase within the same period of 200 in the number of surplus coal cars, which brought the total number for that class of equipment up to 6,293.

The reported car shortage on Aug. 14 amounted to 8,315 cars, a reduction of 1,834 compared with the total on Aug. 7. Shortage in box cars amounted to 2,329, a decrease of 833 within a week, while the shortage in coal cars totaled 4,193, a reduction of 704 under the reported shortage on Aug. 7. Reports showed practically no shortage in other classes of equipment.

Much Building Planned in Britain

Since Jan. 1, Trade Commissioner A. V. Dye reports to the U. S. Department of Commerce, the British Department of Labor has gathered statistics showing the estimated cost of building plans approved from 142 localities in the United Kingdom.

During the first six months of this year building permits in these 142 localities, comprising about one-third of the population of the United Kingdom, amounted to £20,346,700. In June, however, the estimated cost of such building plans approved was £3,861,700, as compared with the average for the previous five months of £3,300,000 per month.

Building is, so far, limited to dwelling houses and large office buildings and construction or re-modeling of general stores, of which there has been a considerable amount noticeable in London and the larger cities. Dwelling houses are limited to two classes of construction: Houses which are built by owners for their own occupancy, and houses which are built by large corporations, such as coal mining companies, to house their employees. In both cases these houses are built without regard to the economic rent derived from the expenditure, as it does not yet pay to build houses to rent. That building and construction in Britain is improving is also indicated by labor conditions in that industry, which showed an improvement in June. The number of unemployed in building and construction has dropped from 182,123 on Jan. 22, to 114,243 on June 25.

Weekly Freight Loading Shows Slight Decrease

Loading of revenue freight for the week ended Aug. 11, according to the Car Service Division of the American Railway Association, totaled 973,162 cars, a decrease of 59,968 cars under the week of Aug. 4, due to the observance

of President Harding's funeral. It was, however, an increase of 130,472 cars over the corresponding week of last year as well as 164,893 cars over the same week of 1921.

While the loading of revenue freight during the week of Aug. 11 for the country as a whole increased 15.5 per cent over the corresponding week last year, the largest increase was 19.2 per cent in the Eastern district, which includes the Allegheny and Pocahontas districts, partially due to decreased coal loading last year on account of the miners' strike.

Large Contracts Let During Week

Among the week's announcements of contracts awarded in Construction News, pp. 115 to 127, are the following:

Temple, Milwaukee, Wis., to Raulf Co., $1,500,000.

Hotel, New York, N. Y., to Lynch Constr. Co., $1,500,000.

Apartment, Long Beach, Calif., to Scofield Eng. Co., Los Angeles, $1,470,000.

Hotel and apartment, Long Beach, Calif., to Scofield Eng. Co., Los Angeles, $1,000,000.

Bids Wanted on Big Jobs

Among the projects on which bids are either asked or will soon be called for, in Construction News, pp. 115 to 127, are the following:

Canal, Port Colborne, Ont., for Dominion Dept. Rys. and Canals, Ottawa, $10,000,000.

Pipe line, Portland, Ore., Bull Run Reservoir, $2,500,000.

Infirmary, Louisville, Ky., for St. Joseph's Infirmary, $1,500,000.

Fill, Erie Canal, Cities of Albany and Watervliet, N. Y., $500,000.

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the the issue of Aug. 2; the next, on Sept. 6.

	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Steel Products:									
Structural shapes, 100 lb.	$3.64	$4.00	$4.20	$3.40	$3.55	$4.20	$3.60	$4.10	$4.00
Structural rivets, 100 lb.	4.40	4.75	4.90	3.75	4.25	5.40	5.00	4.75	6.00
Reinforcing bars, ¾ in. up, 100 lb.	3.54	3.50	3.80	3.20	3.45	3.85	3.65	4.10	3.90
Steel pipe, black, 2½ to 6 in. lap, discount	44%	52%	45%	47%	53–5%	36%	33.2@42.2%	+35%	47.43
Cast-iron pipe, 6 in. and over, ton	62.30	—54.00	63.00	60.20	60.50	69.00	62.00	—62.00	60.00
Concreting Material:									
Cement without bags, bbl.	2.70@2.80	3.00	2.25	2.20	2.50	2.84	2.63	2.90	2.25
Gravel, ¾ in., cu.yd.	1.75	1.90	2.38	2.00	1.85	1.90	2.15	1.25	1.50
Sand, cu.yd.	1.25	1.24	1.89	2.00	1.25	1.00	1.50	1.25	1.25
Crushed stone, ¾ in., cu.yd.	1.75	2.00	2.83	2.00	2.25	3.50	2.15	3.00	1.90
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft.	63.00	40.00	52.25	56.50	42.50@43.75	42.75	41.00	28.00	70.00
Lime, finishing, hydrated, ton	18.20	22.50	22.00	20.00	25.50	24.00	22.00	24.00	21.00
Lime common, lump, per bbl.	3.00@3.25	1.50	2.35	1.50	1.50	2.70	2.10	2.80	10.00
Common brick, delivered, 1,000	23.65	12.00	13.10	11.00	17@19	12.00	15.00	13.00	16.50
Hollow building tile, 4x12x12, per block	Not used	.102	.115	.0724	.0816	.065	.....	.11	1.15
Hollow partition tile 4x12x12, per block	.1573	.102	.115	.....	.....	.065	.108	.11	.....
Linseed oil, raw, 5 bbl. lots, gal.	.98	—1.00	1.14	1.12	—1.02	1.25	—1.16	.86	1.26
Common Labor:									
Common labor, union, hour	.75	.35	.....	.....	.....	.50@.55	.55	.....	.....
Common labor, non-union, hour	....	.30	.30@.50	.82½	.50@.55	.35@.50	.50	.50@.62½	.35@.40

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given: 45-5% means a discount of 45 and 5 per cent. Charge is 15c. per 100 lb. for cutting reinforced steel into 2-ft. lengths or over.

New York quotations delivered, except sand, gravel and crushed stone, alongside dock; common lump lime, in 280-lb. bbl. net, and hydrated lime f.o.b. cars; tile "on trucks"; linseed oil and cast-iron pipe f.o.b.

Labor—Concrete laborers' rate, 93¾c.; building laborers (pick and shovel men) 75c. per hr.

Chicago quotes hydrated lime in 50-lb. bags; common lump lime per 180-lb. net. Lumber delivered on job.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. We quote on brown lime per 180-lb. net; white is $1.80 for Kelly Island and $1.70 for Sheboygan. Common labor not organized.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered, in iron bbl. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered.

San Francisco quotes on Heath tile, size 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco, for No. 1 fir, common.

Seattle quotes on Douglas fir (delivered) instead of pine. Lump finishing lime per 180-lb. net. Hollow building tile delivered. Hydrated lime in paper sacks. Sand and gravel at bunkers.

Montreal quotes on pine lumber. Sand, stone, gravel and lump lime per ton. Cement, lime and tile are delivered; sand, gravel and stone on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 97.68). Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net; 3-in., $47.43; 6-in., $119.

Changes Since Last Week

In keeping with the general unevenness that has characterized the market during the last few weeks, this week's line-up shows an improvement in steel and non-ferrous metals, and depression in cast-iron pipe and linseed oil. Higher production costs, consequent to a shorter working day at the steel mills, have resulted in a solidification of the mill base at around $2.50 per 100 lb. for shapes and plates, and $2.40 for bars.

A buying movement has developed in steel rails, wire and tin plate, while greater activity is reported in steel pipe.

Seattle warehouses report a reduction of five points in black steel pipe discounts and a severe drop in cast-iron pipe prices. Atlanta also quotes a reduction of $2 per ton in c.-i. pipe.

Warehouse prices, generally, have shown little change during the week, especially in lime, lumber, clay products and concreting materials. Linseed oil, however, dropped 2c. in San Francisco and Minneapolis and 8c. per gal. in Atlanta.

Despite the fact that the brick manufacturing season is nearing its close and that a coal shortage is also threatened, the price of brick at New York docks is a trifle easier at $20 per M., wholesale, as against $21, recently. Common brick has been quoted at its present level, in this market, throughout the first half of the current year.